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SILICON MATERIALS TASK OF THE LOW COST SOLAR ARRAY PROJECT (PHASE II)

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Effect of Impurities and Processing on Silicon Solar Cells

Phase III Summary and Seventeenth Quarterly Report

Volume 1: Characterization Methods for Impurities in Silicon and Impurity Effects Data Base

January 1980

R. H. Hopkins, J. R. Davis, A. Rohatgi, R. B. Campbell, P. D. Blais, P. Rai-Choudhury, and R. E. Stapleton Westinghouse Research and Development Center and H. C. Mollenkopf and J. R. McCormick Hemlock Semiconductor Corporation

Contract No. 954331

The JPL Low Cost Silicon Solar Array Project is sponsored by the U. S. Dept. of Energy and forms part of the Solar Photovoltaic Conversion Program to initiate a major effort toward the development of low-cost solar arrays. This work was performed for the Jet Propulsion Laboratory, California Institute of Technology by agreement between NASA and DOE.

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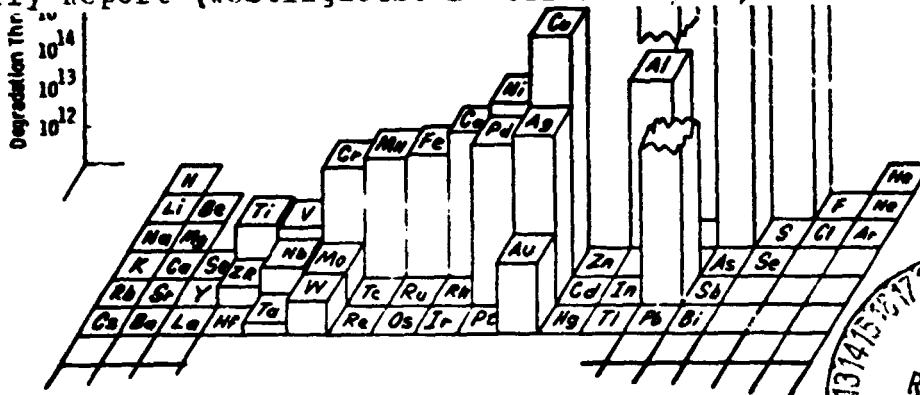
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NEW TECHNOLOGY

No new technology is reportable for the period covered by this report.

## PREFACE

This volume describes the experimental methods used to study the behavior of impurities in silicon solar cells, and the data base accumulated during a study entitled "An Investigation of the Effects of Impurities and Processing on Silicon Solar Cells" conducted under JPL Contract 954331. A companion volume, Volume 2, presents an analysis of the impurity effects in the context of using cheaper, less pure grades of silicon to manufacture low cost terrestrial solar cells.

A number of individuals contributed to the study; the main areas of activity for each are listed below.

- R. H. Hopkins - Program Manager and Silicon Web Studies
- J. R. Davis - Device Testing, Data Synthesis and Modeling
- A. Rohatgi - Detailed Device Analysis and Deep Level Spectroscopy
- R. B. Campbell - Thermochemical Processing and Aging Studies
- R. E. Stapleton - Thermochemical Processing
- P. Rai-Choudhury - Device Processing
- H. C. Mollenkopf - Principal Investigator, Crystal Growth and  
Analysis
- J. R. McCormick - Impurity Analysis

Successful completion of the technical effort depended on the capable assistance of D. N. Schmidt (cell processing and testing), B. F. Westwood (process experiments and photolithography), A. M. Stewart (material characterization and web growth), H. F. Abt (metallization), C. F. Seiler (device measurements), S. Karako (DLTS measurements), and T. Zigarovich (mask preparation). Dr. P. G. Mc Mullins suggestions on the DLTS work were very useful.

Debbie Labor prepared the report manuscript; the text was edited by Suraiya Farukhi.

Dr. Alan Yamakawa served as technical monitor for the program at the Jet Propulsion Laboratory.



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## 1. SUMMARY

This is Volume 1 of a two-volume summary report of the activity performed during Phase III of the Silicon Materials Task of the LSA Project. The object of Phase III of the program has been to investigate the effects of various processes, metal contaminants and contaminant-process interactions on the performance of terrestrial silicon solar cells. The study encompassed a variety of tasks including: (1) a detailed examination of thermal processing effects, such as HCl and  $\text{POCl}_3$  gettering on impurity behavior, (2) completion of the data base and modeling for impurities in n-base silicon, (3) extension of the data base on p-type material to include elements likely to be introduced during the production, refining, or crystal growth of silicon (4) effects on cell performance of anisotropic impurity distributions in large CZ crystals and silicon webs, and (5) a preliminary assessment of the permanence of the impurity effects.

This phase of the work is now completed. In this volume two major topics are treated: methods to measure and evaluate impurity effects in silicon and comprehensive tabulations of data derived during the study. For example, the reader will find discussions of deep level spectroscopy, detailed dark I-V measurements, recombination lifetime determination, scanned laser photo-response, and conventional solar cell I-V techniques, as well as descriptions of silicon chemical analysis. As tools for the sensitive study of impurity behavior in silicon, we think these are topics of importance and of general interest. In the latter portion of the report considerable data are tabulated on the composition, electrical, and solar cell characteristics of impurity-doped silicon. Included therein for example, are lists of impurity segregation coefficients, ingot impurity analyses and estimated concentrations, typical deep level impurity spectra: deep level capture cross sections

and trap densities for many impurities; photoconductive and open circuit decay lifetimes for individual metal-doped ingots, and a complete tabulation of the cell I-V characteristics of nearly 200 ingots. The last section of the report is a compilation of useful thermophysical properties of liquid and solid silicon.

In Volume 2 of the report we present a detailed analysis of the effects of impurities on silicon ingot structure, electrical characteristics and cell performance and the implications of these results with respect to solar grades of silicon.

## 2. INTRODUCTION

This report is a summary of the study conducted under Phase III of JPL Contract 954331. The program's objective is to define the effects of impurities and processing on the characteristics of silicon and terrestrial silicon solar cells, so that poly-silicon manufacturers, wafer manufacturers, and the producers of solar cells can develop cost-benefit relationships for the use of cheaper, less pure solar grades of silicon.

In previous summary reports for Phases I and II<sup>1,2</sup> we described how we established empirically what concentrations of commonly encountered impurities could be tolerated in typical p or n-base solar cells, then developed a preliminary analytical model from which the cell performance could be projected as a function of the kinds and amounts of contaminants in the silicon base material. During Phase III, the impurity data base has been expanded considerably and the model has been refined and broadened to account for additional effects such as base resistivity, grain boundary interactions, thermal processing, and synergic behavior. Studies of non-uniform impurity distributions in commercial-size Czochralski ingots and wide ribbon (web) crystals and potential long term (aging) behavior of impurities were also undertaken. Our results are based on the detailed analysis of nearly 200 silicon ingots.

As in the earlier program summaries,<sup>1,2</sup> we strived to make this report extremely comprehensive and up-to-date (at the risk of reiterating some earlier data) so that the document can stand alone, as a convenient source of information on impurity effects in silicon as they are currently understood. To facilitate the "handbook" aspect of the report, it is separated into two volumes as noted earlier. The first is a complete description of techniques used to evaluate impurities in silicon coupled with tabular compilations of the important findings;



although the emphasis of the report is on the last 18 month's activity, previous analytical results and device data have been revised so far as possible to reflect the most recent information. The second volume of the summary presents an analysis of the experimental results and their implications for the use of solar grades of silicon.

### 3. EXPERIMENTAL EVALUATION OF IMPURITY EFFECTS IN SILICON AND SOLAR CELLS

#### 3.1 Impurity Selection

From the outset this study has been oriented towards the needs of the silicon solar cell community represented primarily by the producers of polycrystalline silicon; the ingot, sheet, or ribbon manufacturers who transform polysilicon to wafers; and the cell manufacturers who employ the wafers to make devices, modules, and arrays. Thus the impurities chosen for study were based on: (1) the presence of the contaminant in metallurgical grade silicon, a raw material in several low cost silicon production processes, (2) the likelihood of introduction during polysilicon production, (3) potential use as a construction material for silicon manufacturing or crystal growth and (4) use as a material for device manufacturing.

The initial impurity matrix<sup>1</sup> included Al, B, Ca, Cr, Cu, Fe, Mn, Ni, P, Ti, V and Zr, common components of metallurgical grade silicon (see section 4.1 for a typical analysis of this material<sup>3</sup>). By adding possible construction materials, potential system contaminants and device contact metals, we developed the matrix depicted in Figure 1 which forms the basis for the present investigation. The impurity ranges examined were dictated by the following criteria:

Impurity	Approximate Concentration Range ( $10^{15} \text{ cm}^{-3}$ )
Aluminum*	3 - 50
Boron*	
Calcium	0. 1
Carbon**	20 - 500
Chromium (†)	0. 1 - 1. 1
Cobalt	0. 054 - 3. 0
Copper (†)	0. 4 - 60
Iron (†)	0. 02 - 1. 5
Magnesium	0. 003 - 0. 03
Manganese (†)	0. 01 - 1. 3
Molybdenum	0. 000046 - 0. 0042
Nickel	0. 4 - 4. 0
Niobium	<0. 044
Oxygen**	500 - 1700
Palladium	6. 5
Phosphorus* (†)	1. 0 - 150
Silver	2. 20
Sodium	
Tantalum	0. 0003 - 0. 004
Tin	4846
Titanium (†)	0. 00036 - 0. 36
Tungsten	0. 0015 - 0. 0014
Vanadium (†)	0. 0004 - 0. 4
Zinc	<0. 001
Zirconium	<0. 0007

\* Boron, phosphorus and aluminum are electrically active impurities and therefore cause variations in resistivity when used as a secondary impurity.

\*\* Oxygen and carbon concentrations measured in approximately 50 ingots doped with additional impurities. Two carbon doped ingots prepared to determine effect of carbon.

† See Text

Figure 1 Impurity Matrix

- 1) the maximum solid solubility of the impurity in silicon,<sup>4</sup>
- 2) the maximum liquid impurity concentration which permits single crystal growth,<sup>5</sup>
- 3) the detection limits of the chemical analysis methods,<sup>6,7</sup> and
- 4) the threshold concentration for solar cell performance degradation.<sup>1,2</sup>

The maximum impurity concentration for a given species was fixed by criteria 1) or 2) while the minimum concentration was determined by criterion 4).

Each test ingot contained an electrically active dopant, either B or P, as well as the secondary metal contaminant. The target resistivities were 4-6  $\Omega$ cm for the p-type B-doped ingots and 1-3  $\Omega$ cm for the n-type P-bearing ingots. A limited number of 0.2  $\Omega$ cm p type ingots were grown (+, Figure 1), as well as two 30  $\Omega$ cm p type ingots containing Ti.

### 3.2 Ingot Preparation and Evaluation

#### 3.2.1 Crystal Growth

All ingots save five which were float-zoned were prepared by Czochralski pulling. This method offers several advantages including: 1) a relatively flat doping profile, 2) the addition of impurities either before or after melt-down, 3) the ability to significantly vary growth conditions and 4) the possibility to sample the melt at the completion of crystal growth to determine melt impurity concentration. Two crystal growth furnaces were used during the program. Phase I ingots were prepared in an NRC-2805 crystal growth furnace. To provide more material subsequent ingots were grown in the HAMCO CG-800 crystal growth furnace. The characteristics of both pieces of equipment are summarized in Table 1.

A new quartz crucible was used for each ingot. Prior to loading the crucible into the furnace, the graphite heating element and graphite furnace parts are baked-out for a period of four hours at

Table 1. Crystal Growth Furnace Characteristics

Furnace Type	NRC 2805	Hamco-800CG
Charge Wt.	0.85-1.2kg	1.2-5.0kg
Crucible Size	10.2 x 12.6cm	15.2 x 12cm
Ingot Dia.	2-5cm	1.0-8.5cm
Ingot Length	15-20cm	20-30.5cm
Growth Atmosphere	1 Atm. Argon	1 Atm. Argon
Gas Flowrate	10 l/min.	50 l/min.
Seed Rot.	13-22 rpm. cw	10-15 rpm. cw
Crucible Rot.	3-5 rpm. ccw	3-6 rpm. ccw
Pullrate	2.5-20 cm/hr.	2.5-15 cm/hr.
Crucible Liferate	variable	variable

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1500 degrees centigrade. Vacuum bake-out is employed with the NRC furnace while an argon ambient is used with the HAMCO CG-800.

Number-one Dow Corning semiconductor grade silicon nuggets or one piece crucible charges were used throughout the entire program. Typical characteristics of this material can be found in Section 4.2. The impurities in the polycrystalline silicon are sufficiently low in concentration that their presence does not affect solar cell performance. Numerous undoped baseline audit ingots were prepared throughout the program to evaluate both the charge material and potential contamination from the growth furnaces. No degradation in the cell performance of devices made from these ingots has been observed.

High purity (99.99% or better) metal dopants were employed throughout the program. The form, purity, and melting points of these materials are listed in Section 4.3. Impurities with high melting points and low vapor pressures are added to the crucible charge prior to melt-down. Impurities melting at temperatures below silicon, or which exhibit high vapor pressure, are added to the molten silicon prior to initiation of crystal growth. The amount of impurity added to the melt was based on the target impurity concentration in the ingot and the best available value for the effective segregation coefficient.

The effective segregation coefficient for each metal contaminant was determined as follows. The melt was purposely doped with a carefully weighed amount of metal. A single crystal ingot was grown and then analyzed by a combination of spark source mass spectroscopy and neutron activation (see section 3.2.2). A rapidly quenched sample of the residual melt was extracted and analyzed by atomic absorption spectroscopy. The ratio of the solid (ingot) impurity concentration  $C_s$  and liquid impurity concentration  $C_l$  gives  $k_{eff}$ . The values of  $k_{eff}$  are tabulated in Section 4.4.

Growth conditions varied little from ingot to ingot. Unless noted otherwise, pull speed ranged between 7 and 8.5 cm/hr; crystal rotation rate was about 10 rpm and crucible rotation rate about 3 rpm.

The majority of the ingots had 3 cm diameters; several Phase III ingots were grown with more conventional 7.6 cm diameters. All the crystals were oriented along  $\langle 111 \rangle$  and grown in an argon atmosphere. Limited experiments were conducted at pull rates as low as 2 cm/hr. or as high as 15 cm/hr. For the rapidly-pulled ingots we found the segregation coefficient increased by about a factor of 1.5 compared to ingots grown at 7 cm/hr. Specific information on growth conditions for each ingot are kept in a master file of ingot data sheets and is available on request.

Five ingots were grown by the float zone method using a Siemens VZA-3 float zone. One baseline ingot was grown using a previously grown Czochralski ingot as feedstock. The other four ingots were prepared from doped polycrystalline silicon. Chromium and aluminum metals were used to dope two of these ingots without experimental difficulty. Use of titanium metal directly as a dopant caused loss of zone stability and the formation of polycrystalline structure. A vacuum cast heavily doped polycrystalline silicon rod was subsequently prepared and welded into the polycrystalline feedstock to be zone refined. This technique proved successful, and a titanium doped ingot was grown.

Besides the nearly 200 silicon ingots produced so far as part of the program, about 60 dendritic web<sup>8</sup> growth runs have also been carried out to evaluate impurity effects in ribbon-type silicon materials. These crystals, up to 4 cm in width, were grown from 60g (Phase I and II) and 180g (Phase III) melt charges at speeds ranging between 79 and 120 cm/hr. The same type metal dopants and polycrystalline feedstock used for the Czochralski ingots were also used to grow web crystals.

All ingots were centerless ground to the nominal 3 or 7.6 cm diameter after growth, and then etched (7 parts  $\text{HNO}_3$ /1 part HF) to remove surface damage. The web crystals were cleaned by swabbing with HF to remove oxide deposited on the surface during growth.

### 3.2.2 Ingot Characterization

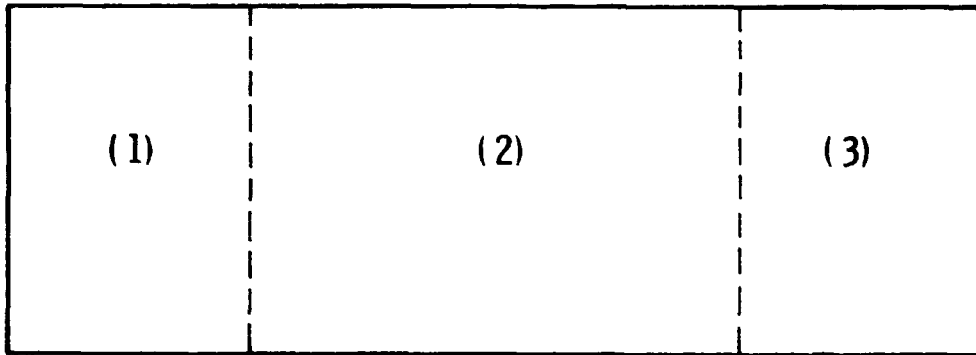
Several complementary analytical methods were employed to characterize the crystal quality, chemistry and electrical properties of the as-grown ingots. The sampling procedure is depicted in Figure 2. Specimens for etch pit density, IR transmission, spark source mass spectroscopy (SSMS), and neutron activation (NAA) were taken primarily from region (1) although some analyses were also performed on material from region (3). All wafers came from region (2). The weight of ingot used through the seed end analytical material and solar cell blank slices was limited to no more than 25 percent of melt weight. This assured small variations of the impurity concentration along the length of material evaluated. Neutron activation analyses of seed and tang end samples from several doped ingots indicated total changes in impurity concentration along the length of the ingot to be a maximum of 47 percent (i.e., in the case of manganese). Variation within the region devoted to solar cell blanks was significantly less than this extreme.

During Phase I a total of 75 solar cell blanks were cut from each ingot; in Phase II and III this number was increased to 150. Analytical samples taken from Phase I material were limited to slices for SSMS measurements, infrared absorption, resistivity, and for etching experiments to determine dislocation density. Additional slices for neutron activation analysis, lifetime measurements, and independent JPL testing were cut from Phase II and III ingots. Analytical slices were excised with an OD diamond saw, while all solar cell blanks were cut with an ID diamond saw. A tapered bevel was ground along the length of each ingot producing a flat at the circumference of each wafer. The length of this flat increased from the seed to tang end of an ingot so the relative positions of each wafer could be identified.

#### Resistivity

Resistivity was measured on the seed and tang end of each ingot with a Siltec-1000 four point probe. Longitudinal resistivity measurements were also made at 1 cm intervals along the ingot length.

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(1). 3 cm Seed Analytical Material ( IR, SSMS, NAA, etching)

(2). 12.5 cm Solar Cell Blank Material

(3). 3 cm Tang Analytical Material ( SSMS, NAA, etching)

Ingot Wt. 0.3 – 0.6 kg. ( 3 cm dia. ), 2.8 – 3.3 kg ( 7.6 cm dia. )

Charge Wt. 0.85 – 1.5 kg. ( 3 cm dia.), 2.8 – 3.3 kg ( 7.6 cm dia. )

Figure 2 Silicon Ingot Sampling



The targeted and measured resistivities for all ingots are collected in Section 4.5. Except for a few ingots where suspected metal-boron interactions produced resistivities up to 9  $\Omega\text{cm}$ , the target 4 to 6  $\Omega\text{cm}$  ( $N_A = 4 \times 10^{15} \text{ cm}^{-3}$ ) resistivity was achieved with no difficulty. Ingots compensated with phosphorus also produced higher resistivities, as expected. The n-type ingot resistivities fell in the target range 1 to 3  $\Omega\text{cm}$  ( $N_D = 4 \times 10^5 \text{ cm}^{-3}$ ).

#### Etch Pit Density

The etch pit density was measured on seed and tang specimens following Sirtl etching.<sup>9</sup> The slices examined were taken from the extreme ends of regions (1) and (3), Figure 2. The etch pit density of the solar cell blanks was most comparable to that of the seed material, typically  $10^3 \text{ cm}^{-2}$  or less, as can be seen from the data compilation in Section 4.5. Tang and densities sometimes reached  $10^5$  to  $10^6$  dislocations  $\text{cm}^{-2}$  when structural breakdown occurred due to impurities (see Volume 2). As high as 30 percent of the ingots were dislocation free although no special effort was taken to achieve this result.

#### Carbon and Oxygen Analysis

Carbon and oxygen concentrations were measured by infrared absorption. The amplitude of the absorption peak for carbon at  $606 \text{ cm}^{-1}$  and oxygen at  $1107 \text{ cm}^{-1}$  are proportional to the elemental concentrations. Constants of proportionality for this work were 2.2 for carbon and 9.6 for oxygen. As can be seen from the tabulation in Section 4.6 the carbon and oxygen contents of the ingots we sampled fell in the typical ranges for Czochralski crystals:  $2.5 \times 10^{16}$  to  $5 \times 10^{17} \text{ cm}^{-3}$  for carbon and  $5 \times 10^{17}$  to  $1.5 \times 10^{18} \text{ cm}^{-3}$  for oxygen. In two purposely-doped ingots greater carbon concentrations were achieved.

#### Impurity Analysis

Precise and accurate determination of impurity concentrations is fundamental to the success of the program. The maximum melt concentration which could be achieved for the majority of elements studied was in the range of  $1 \times 10^{20}$  atoms  $\text{cm}^{-3}$  to  $4 \times 10^{20}$  atoms  $\text{cm}^{-3}$ . Higher melt concentrations resulted in polycrystalline ingot growth. This concentration

limit coupled with the extremely small effective segregation coefficients for many of the impurities (Section 4.4) means that ingot concentrations ranging from below  $10^{12} \text{ cm}^{-3}$  to as high as  $10^{16} \text{ cm}^{-3}$  are encountered. The corresponding detection limits for chemical analysis are thus from about 0.02 parts per billion to 200 parts per billion, ranges generally accessible only by spark source mass spectroscopy or neutron activation analysis, as suggested in Table 2. Chemical separation combined with neutron activation analysis provides the lowest detection limits; however, budgetary limitations and the longer turnaround times on the measurements limited the number of ingots we analyzed this way.

Each ingot was analyzed by SSMS, NAA or by both methods. A vacuum cast sample, collected from the residual melt of each growth run, was analyzed by emission spectroscopy or atomic absorption to provide the melt impurity concentration. Segregation coefficients determined for the most heavily doped ingots were used to calculate the ingot impurity concentration in cases where the ingot impurity level fell below the detection limits of all the analytical methods.

Analytical slices for SSMS or NAA (Figure 2) were given a double sequential etch in a 1HF: 1HNO<sub>3</sub> solution. Excess nitric acid was used to terminate each etch cycle and samples were then rinsed in deionized water. SSMS analysis of updoped samples prepared in this manner produced photoplates clear of any of the impurities under investigation. Slight traces at  $m/e = 40$ , and 20 (attributed to argon,) and a trace at  $m/e=48$  (ascribed to the oxygen molecule) were, however, noted.

The measured concentrations of the intentionally added impurities are compiled in Section 4.7. In the tables the target concentration is derived by multiplying the melt concentration (based on atoms of melt and atoms of impurity element added) times the effective segregation coefficient. The target values shown in Section 4.7 have been updated to reflect the best available values of  $k_{\text{eff}}$ . The calculated concentrations represent the product of measured melt concentration corrected for the amount of melt solidified and the effective segregation coefficient. Measured concentrations are averaged SSMS data;

Table 2. Typical Detection Limits of Analytical Techniques  
Employed in this Investigation  
(References 6 and 7)

Method of Analysis Impurity	Resistivity (ppba)	Infrared (ppba)	Mass Spec (ppba)	NAA (ppba)/ Routine (ppba)
Aluminum	4		50	---
Boron	<1		3	---
Carbon		$\sim 5 \times 10^2$	500	---
Chromium			3	0.04/5
Cobalt			50	0.006/31
Copper			15	0.006/3
Iron			30	$\sim 1/20 \times 10^3$
Magnesium			5	$\sim 20/3,800 \times 10^3$
Manganese			3	.002/2
Molybdenum			10	0.01/5
Nickel			30	$0.2/8 \times 10^3$
Niobium			3	---
Oxygen		$\sim 100$		
Palladium			10	0.84/40
Silver			6	0.008/100
Tantalum			10	0.001/5
Tin			3	0.028/8500
Titanium			5	0.5/-
Tungsten			3	0.0001/13
Vanadium			3	$\sim 20/-$
Zinc			5	3/600
Zirconium			12-15	0.5/200

the figures in parenthesis are NAA data. The N/A entries indicate that no impurity, save the desired donor or acceptor, was added to the ingot.

Some effort also was expended to provide assurance that unintentionally added impurities were not present in doped and undoped ingots. Since the sensitivity of the SSMS measurements is inadequate to detect the majority of potential contaminants below the concentration of approximately  $1.5 \times 10^{14}$  atoms  $\text{cm}^{-3}$ , NAA\* was used to survey over 20 selected ingots. Typical concentrations of the unintentionally-added impurities are given in Table 3. Note that all detected impurity concentrations are well below concentrations which would have any impact on solar cell performance.

An evaluation of the statistical significance of the chemical analysis data is presented in Volume 2 of this report. However, we note here that good agreement exists between the target and calculated concentrations in Section 4.7 except for impurities like Zn which vaporize easily during growth. While we considered the melts properly doped when the calculated value was within  $\pm 60$  per cent of the target value, agreement was usually much better than this.

Based on the totality of the analytical data and the measured segregation coefficients for each impurity, we have derived a best estimate of the impurity concentration for each ingot produced during the program. These best estimates, Section 4.8, are used as a basis to evaluate the electrical and solar cell data, to compare impurity behavior, and to formulate conclusions with respect to solar grades of silicon.

### 3.3 Electrical Characterization of Impurity-Doped Silicon

Since a major objective of this program is to quantify the relationships between the impurity content and electrical characteristics of contaminated silicon, we have developed and utilized several sophisticated

\*Neutron activation analysis was performed at General Activation Analysis, San Diego CA, and Kraffwerk Union A.G., Erlangen, FDR.

TABLE 3. Concentrations of Unintentionally-added Impurities

<u>Impurity</u>	<u>Concentration</u>	
	<u>Atoms/cm<sup>3</sup></u>	<u>(ppb<sub>a</sub>)</u>
Antimony	$8.1 \times 10^{11}$	(0.0026)
Arsenic	$7 \times 10^{12}$	(0.14)
Chromium	$2 \times 10^{12}$	(0.04)
Copper	$5 \times 10^{12}$	(0.1)
Gallium	$2.5 \times 10^{12}$	(0.07)
Gold	$\sim 1 \times 10^9$	(.00002)
Iron	$< 5 \times 10^{13}$ *	(<1)
Nickel	$< 5 \times 10^{12}$	(<0.1)
Titanium	$< 8 \times 10^{13}$	(<1.6)
Zirconium	$< 3 \times 10^{13}$	(<0.6)

\* Iron was detected at concentrations of  $1 \times 10^{14}$  -  $1.7 \times 10^{14}$  atoms/cm<sup>3</sup> in ingots heavily doped with nickel.

techniques to evaluate the effects of trace amounts of impurities. In the sections that follow we describe how such methods as deep level spectroscopy, detailed I-V analysis, photoresponse, recombination lifetime measurement, and laser spot scans can be coupled with standard solar cell I-V measurements to build up a detailed picture of impurity behavior in single and polycrystalline ingots. Evaluation, correlation, and modeling of the data collected is the subject of Volume 2 of the report.

### 3.3.1 Impurity Analysis by Deep Level Transient Spectroscopy

Deep level transient spectroscopy provides a means to evaluate the type and concentration of electrically active contaminants present in silicon at levels well below the limits accessible by standard chemical methods like those described in Section 3.2. The method can be used to evaluate both silicon ingots and solar cells, as well as to observe changes in impurity activity due to thermal processing. We outline below the manner in which DLTS measurements are made, analysis of the data, and procedures for specimen preparation; typical impurity spectra, tabulations of deep levels and trap densities in ingots and cells, and capture cross section data can be examined in Sections 4.9 to 4.12.

#### 3.2 1.1 Background

Deep levels play a significant role in controlling the carrier lifetime in semiconductors. Impurities introduce recombination centers in silicon and, thereby, degrade solar cell performance. In the absence of recombination centers, carriers recombine by the process of band to band recombination and lifetime is fairly long. Deep levels act as "stepping stones" for the recombination process and the lifetime is reduced. In the presence of a deep level the carrier lifetime becomes a function of the energy ( $E_T$ ), density ( $N_T$ ), and the capture cross section ( $\sigma$ ) of the impurity level.

Deep level transient spectroscopy has become an attractive and powerful technique to characterize the recombination centers in semiconductors because a) it is capable of providing information about energy, density, and the capture cross section of the centers, b) it can be used to distinguish between the majority and minority carrier traps, c) it is very sensitive (detection limits well below chemical methods), rapid and straight forward to analyze and d) it can detect both radiative and non-radiative centers over a wide range within the bandgap. This technique was developed by Lang<sup>10</sup> and is well documented in the literature<sup>11</sup>. Because the method is so useful we describe it in some detail below.

### 3.3.1.2 Generation of Capacitance Transients

The DLTS technique is a capacitance transient thermal scanning technique. Figures 3 and 4 illustrate pictorially how capacitance transients are generated to study the traps in the junction of a semiconductor device. A reverse biased device is pulsed to fill the traps in the depletion region. At the end of the pulse, the capacitance does not return to its original value because of the trapped charges. At temperatures where sufficient excitation energy is present, these charges are released by thermal emission, producing a capacitance transient. In this technique the device temperature is raised from liquid N<sub>2</sub> temperature to vary the emission rate or the time constant of the transient, Figure 5. These transients are processed by a signal averager to provide an output signal as a function of device temperature which passes through a maximum. The sign of each peak indicates the hole or electron trap. The proper choice of experimental parameters can give the activation energy, density, concentration profile and the capture rate of the trap.

Majority carriers alone can be injected by a majority carrier pulse which reduces the reverse bias as well as the depletion region width (Figure 3). In order to study minority carrier traps, an injection pulse is applied either by forward biasing the device or by photo injection, (Figure 4). An injection pulse introduces both majority and minority carriers and the resulting population of the states is

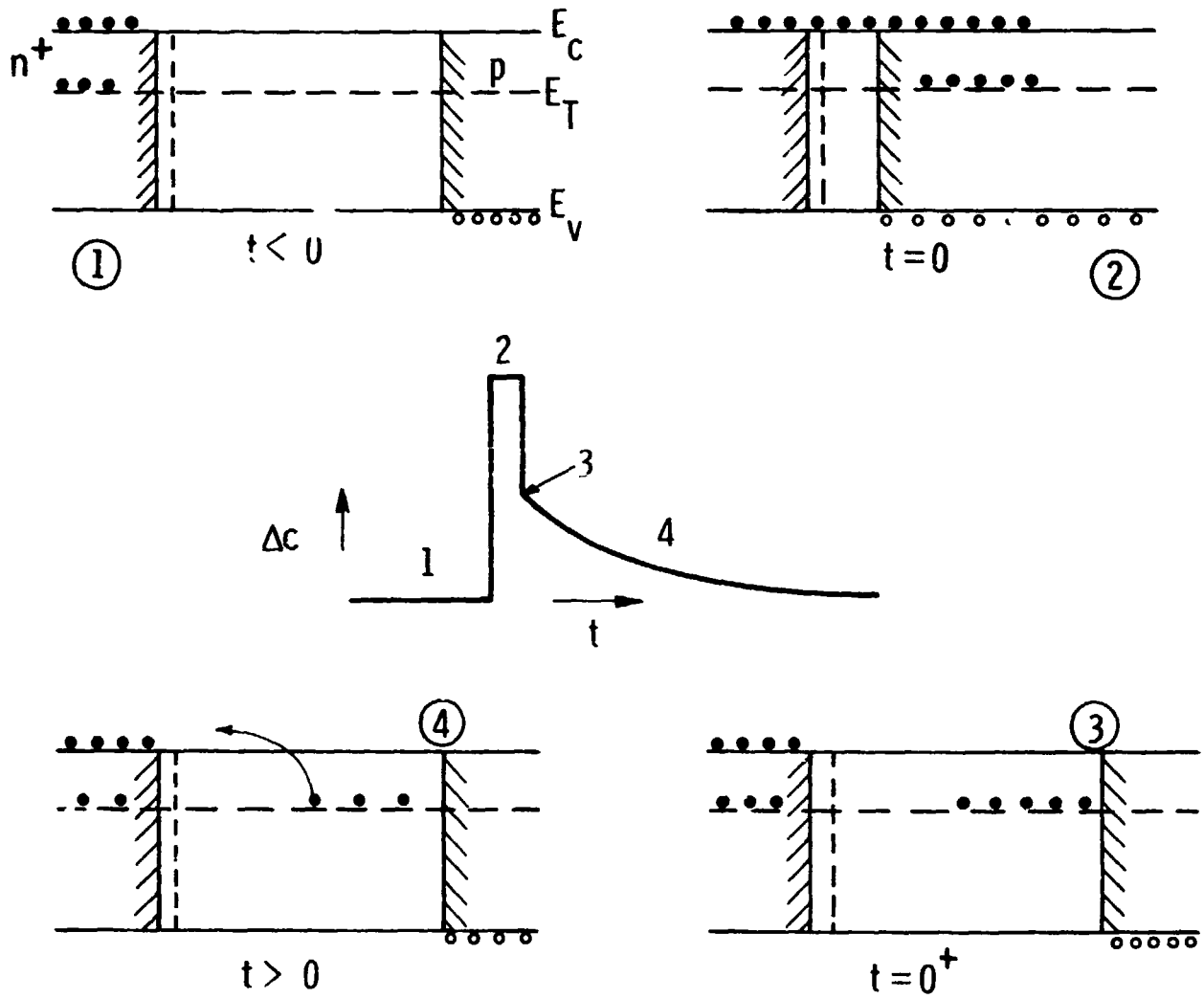


Figure 3 Capacitance Transient Due to Minority Carrier Trap



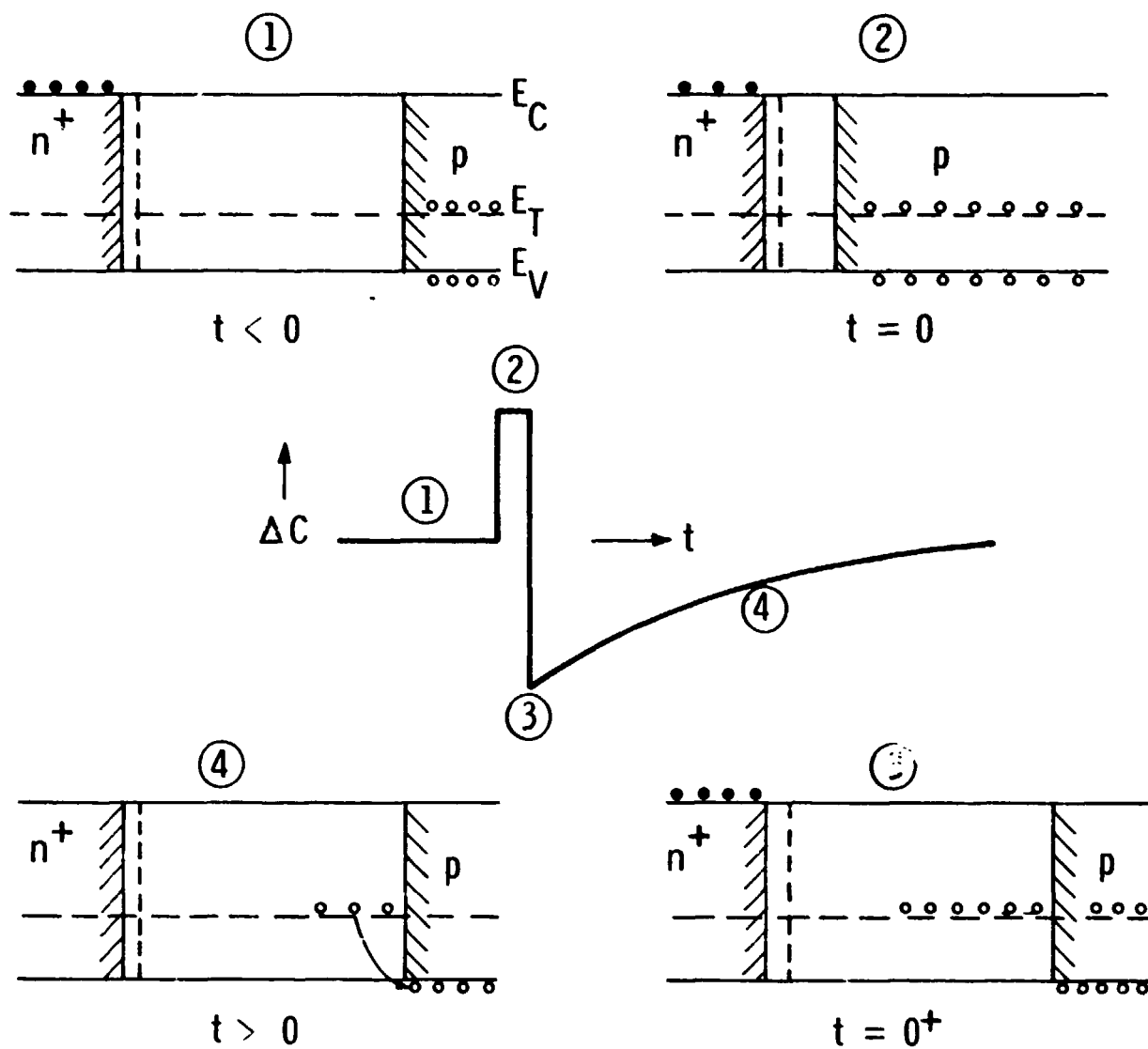
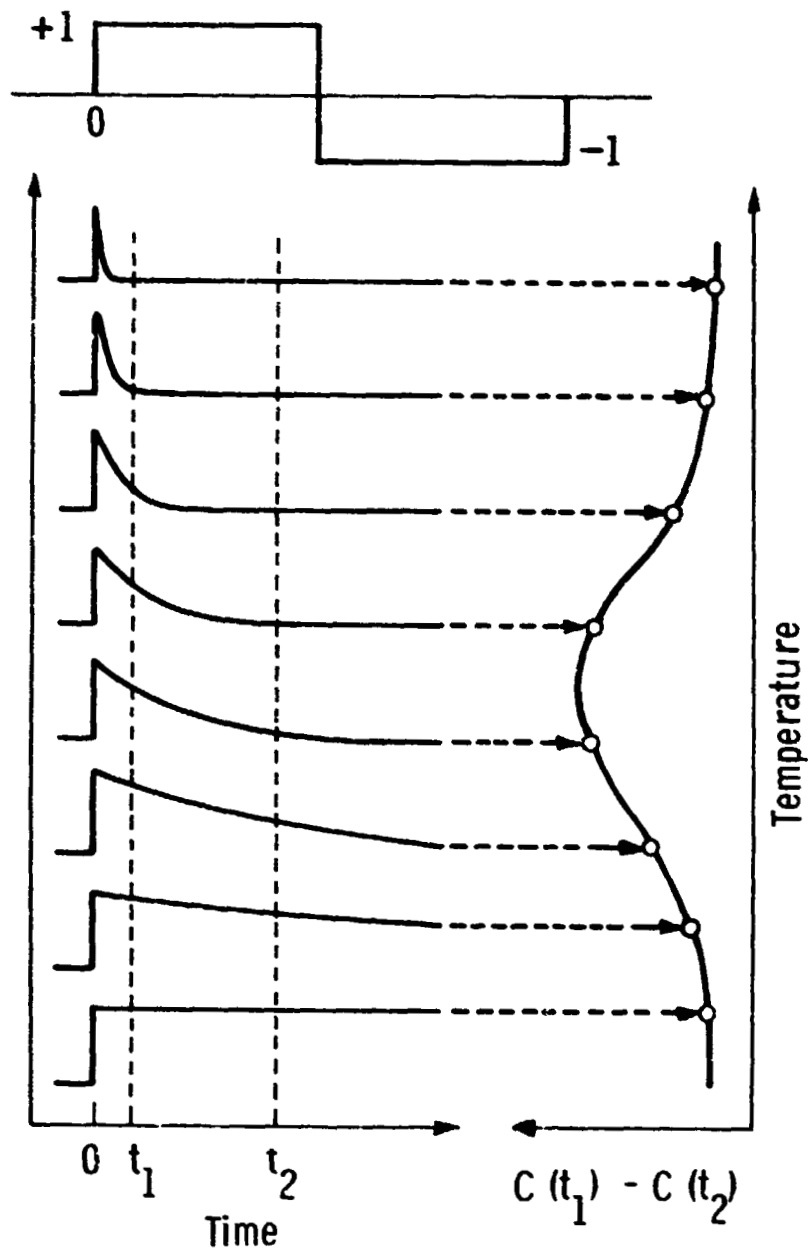


Figure 4 Capacitance Transient Due to Majority Carrier Trap



$$\tau_{\max} = \frac{t_1 - t_2}{\ln(t_1/t_2)}$$

$$e = \frac{1}{\tau_{\max}}$$

Figure 5 Evolution of a capacitance transient with time and temperature

determined by the competition for the capture of the two types of carriers. The relative ratio of the injected minority and majority carriers can be varied by controlling the magnitude of the injection current. Under high level injection  $[maj]/[min]$  approaches unity and the trapped minority carrier population approaches  $\sigma_{min}/(\sigma_{min} + \sigma_{maj})$ . The minority carrier capture measurements are generally less reliable and more complicated than the majority carrier measurements because the injected carrier density must be determined by a detailed analysis of injection mechanism<sup>10,12</sup>.

### 3.3.1.3 Experimental Arrangement for DLTS Measurements

The DLTS measurement system consists of a sensitive capacitance meter with good transient response, pulse generators, a signal integrator, an X-Y recorder and a variable temperature cryostat. Previously we described a DLTS system which used a double boxcar integrator<sup>2,13</sup>. Since then we have developed a DLTS system which utilizes a lock-in amplifier as the integrator.

The system, Figure 6, consists of a time base generator which provides the reference signal for the lock-in amplifier, a hold signal for a sample and hold module, and a trigger pulse for the bias pulse generator. All of these signals are derived by digital counting circuits from a crystal controlled clock. Figure 7 illustrates how the signals at various stations of the system are related. The trigger pulse can be moved anywhere within the holding interval  $2X$ , where  $X = 0.02N$  msec and  $N$  can be selected on the time base generator ranging from 0-8000. The D.C. bias is applied through the capacitance meter; the bias pulse to inject the carrier is applied through a pulse transformer, Figure 8.

The transients are sent first to a capacitance meter. The output of the capacitance meter is transmitted to a sample and hold module, prior to the lock-in, which functions to blank out the large output transient caused by the bias pulse and its subsequent recovery. The output of the lock-in amplifier given by equation (1), is displayed on an x-y recorder as a function of the device temperature.

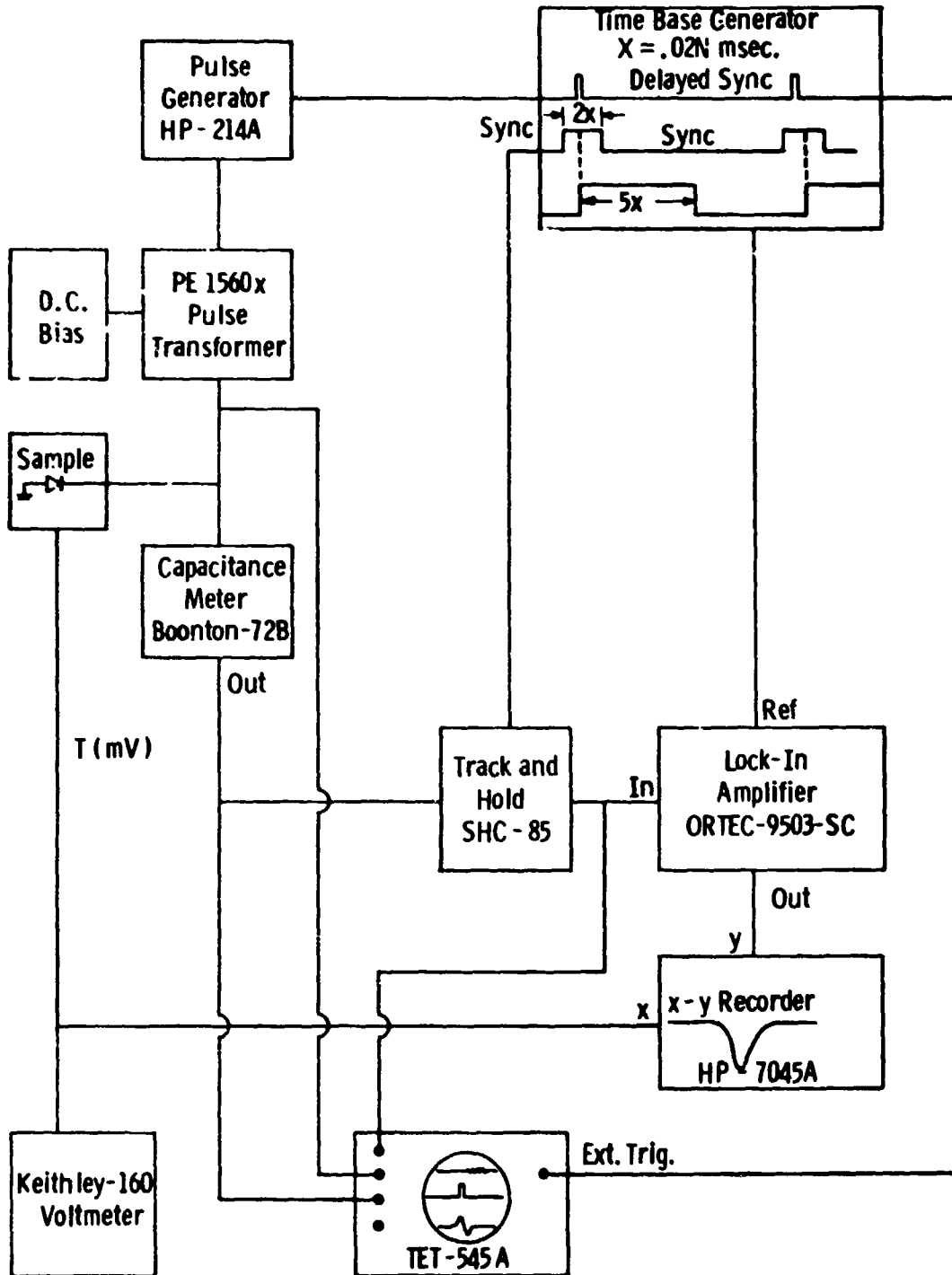


Figure 6 Schematic Diagram of the DLTS Apparatus

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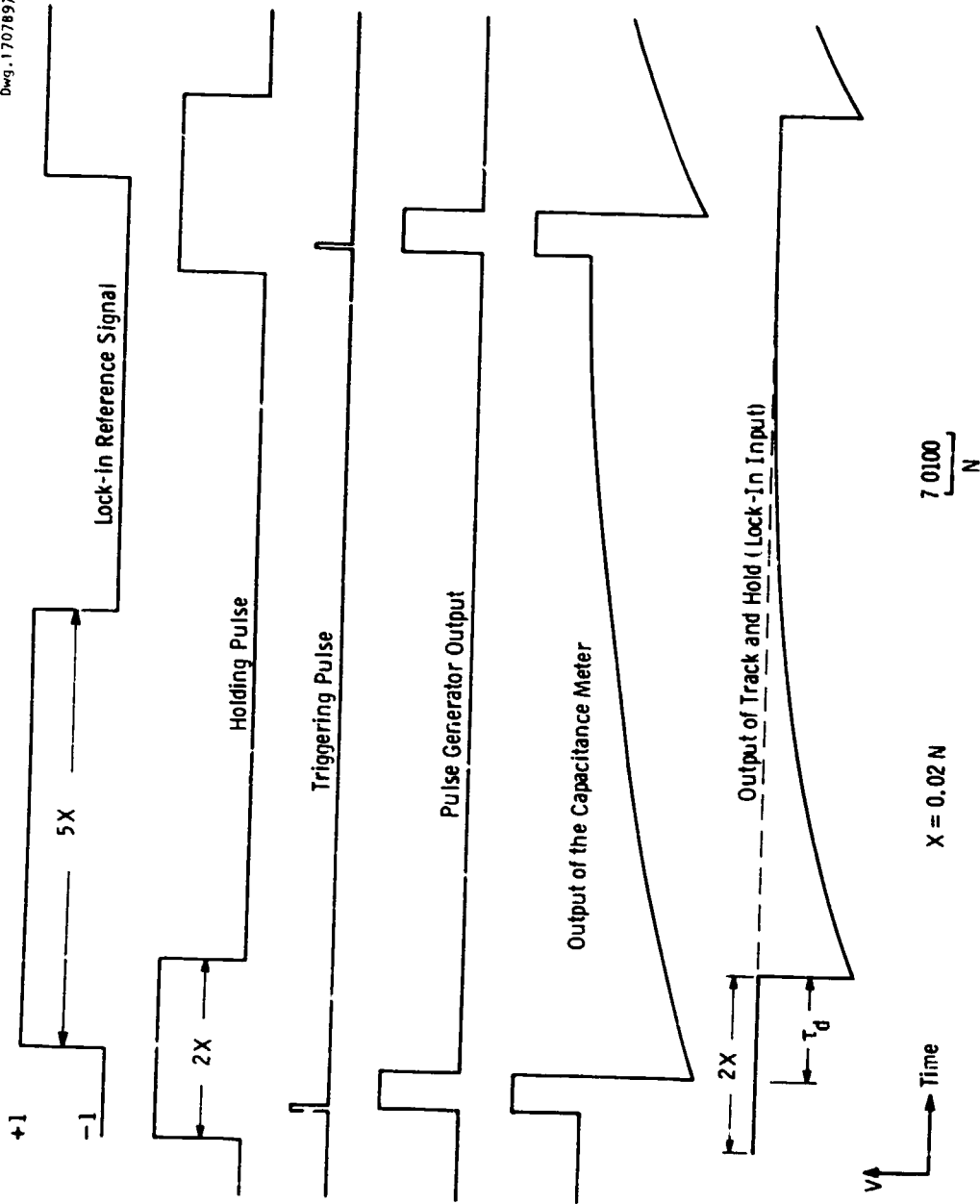


Figure 7 Schematic Diagram of the Signals in the DLTS Set-Up

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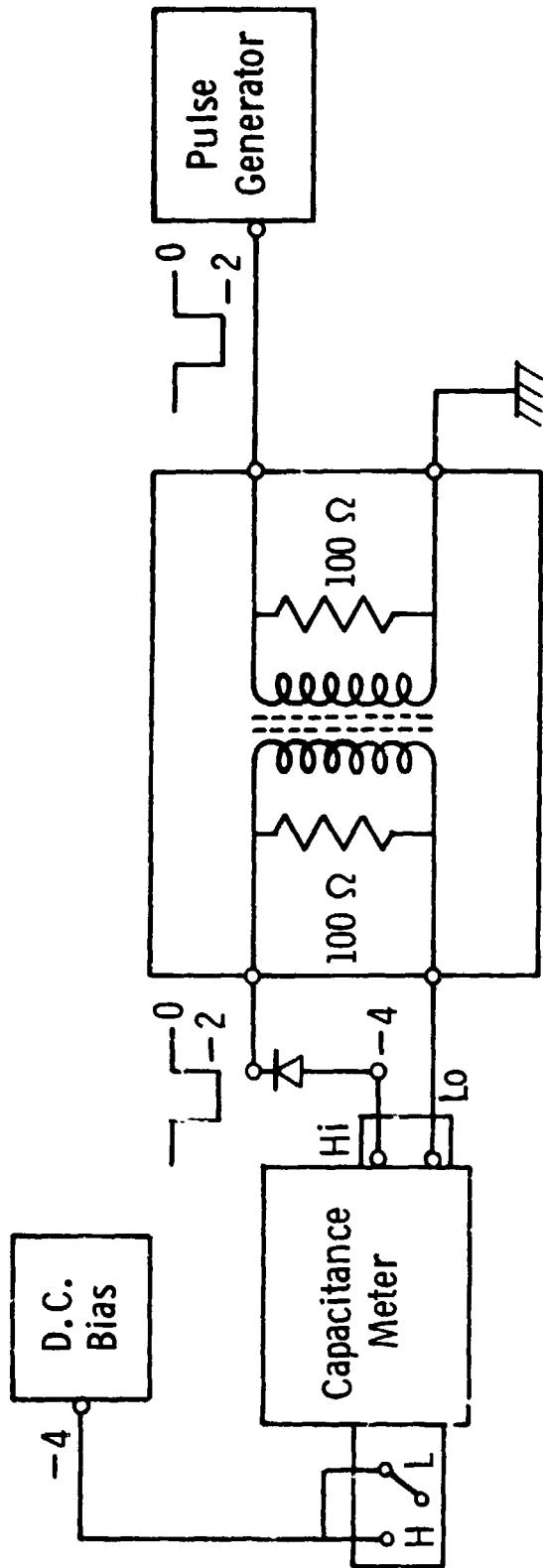


Figure 8 Bias Arrangement for the DLTS Set-Up

$$L = \frac{G_L}{T_B} \int_0^{T_B} S(t) W(t) dt \quad (1)$$

where  $T_B = 10X$ ,  $G_L$  is the gain of the amplifier,  $W(t)$  is the weighting function or the reference signal and  $S(t)$  is the output of sample and hold module. The sample and hold module give a constant output during the holding interval.

Assuming exponential transients inputs to the lock-in can be written as (see Figure 9):

$$S(t) = \begin{cases} K & \text{for } 0 < t < 0.1 T_B \\ \Delta C_o G_c \exp \left( - \frac{t - 0.1 T_B + T_d}{\tau} \right) & \text{for } 0.1 T_B < t < 0.9 T_B \\ K & \text{for } 0.9 T_B < t < T_B \end{cases} \quad (2)$$

and

$$W(t) = \begin{cases} +1 & 0 < t < 0.5 T_B \\ -1 & 0.5 T_B < t < T_B \end{cases} \quad (3)$$

where  $G_c$  is the gain of the capacitance meter,  $\Delta C_o$  is the capacitance change at the end of the bias pulse, and the delay time  $T_d$  is the interval between the end of the bias pulse and the end of the holding interval.

Equations (1), (2), and (3) give

$$L = \frac{G_c G_L \tau_e \Delta C_o}{T_B} e^{-T_d/\tau} \left\{ 1 - \exp \left( - \frac{T_e}{2\tau} \right) \right\}^2 \quad (4)$$

where  $T_e = 0.8 T_B$

The time constant of the transient for which the output is maximum ( $\tau_p$ ) is obtained by  $dL/d\tau = 0$  which gives

$$\left( 1 + \frac{T_d}{\tau_p} \right) - \left\{ \exp \left( - \frac{T_e}{2\tau_p} \right) \right\} \left\{ \frac{T_e}{\tau_p} + \left( 1 + \frac{T_d}{\tau_p} \right) \right\} = 0 \quad (5)$$

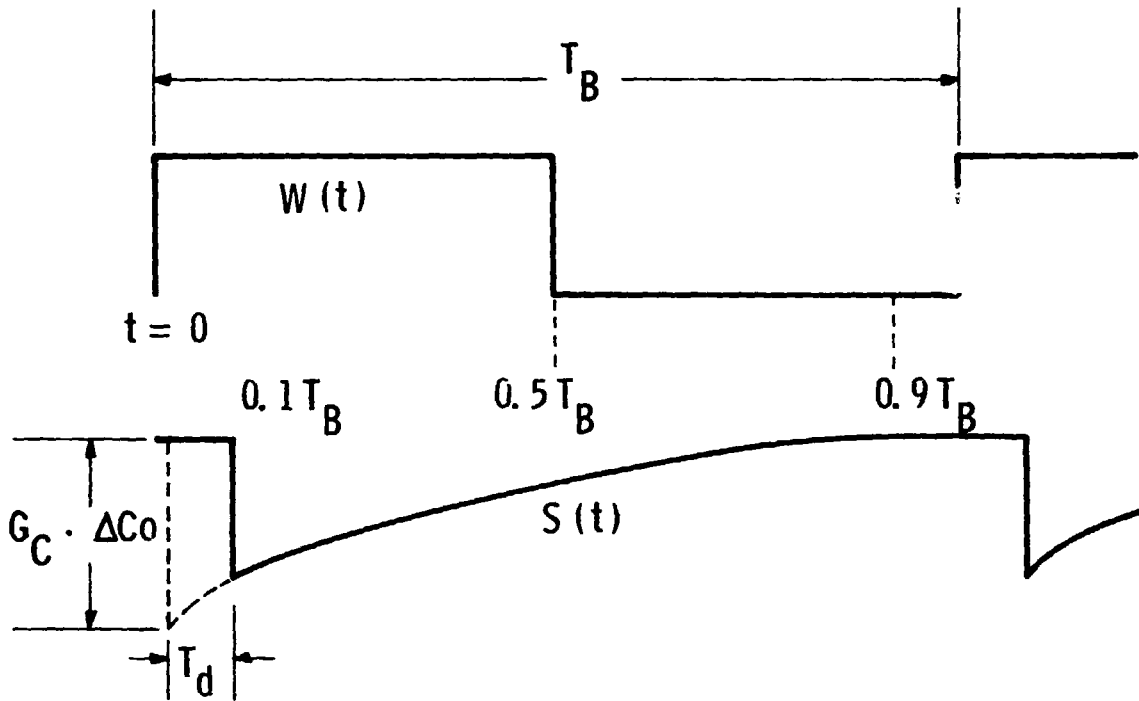


Figure 9 Schematic Diagram of the Weighting Function and the Input Signal to the Lock-in Amplifier



This transcendental equation is solved for  $\tau_p$  by Newton's method using a computer program. Figure 10 depicts the relationship between  $\tau_p$  and  $T_B$  for  $T_d = 1$  msec. Thus the emission rate or the time constant of the transient ( $e = \frac{1}{\tau}$ ) at the peak temperature is fixed by the choice of  $T_B$  and  $T_d$ .

### 3.3.1.4 Determination of Trap Parameters

Activation Energy of the Trap: A different value of  $T_B$  is selected for each scan which moves the peak to a different temperature Figure 11; Typical impurity spectra for other impurities appear in Section 4.9). Each peak gives an emission rate at the peak temperature. The emission rate is given by

$$e = \frac{N_c \sigma v_{th}}{g} \exp(-\Delta E/KT) \quad (6)$$

where  $g$  is the degeneracy of the level,  $N_c$  (or  $N_v$ ) is the effective density of states in the band with which trapped carriers communicate. If the capture cross section ( $\sigma$ ) is independent of temperature, then the activation energy ( $\Delta E$ ) represents the depth of the trap from the band edge to which carriers are emitted. For  $\sigma = \sigma_0 e^{-E_\sigma/KT}$ , the trap depth is given by  $\Delta E - E_\sigma$ . The product  $N_c \cdot v_{th}$  is proportional to  $T^2$ , therefore, the activation energy of the trap is determined from the Arrhenius plot of  $\log e/T^2$  versus  $1/T$ , as illustrated for vanadium in Figure 12.

Trap Density The density of the trap center ( $N_T$ ) can be obtained from the knowledge of  $\Delta C_0$  provided the pulse is large enough to fill all the traps, the trap and the doping density is spatially uniform and  $N_T \ll N_D - N_A$ . For these conditions

$$N_T = 2 \frac{\Delta C_0}{C} (N_D - N_A) \quad (7)$$

where  $C$  is the capacitance of the reverse biased depletion region and  $N_D - N_A$  is the net doping (for n-type material). Equation (7) can be derived from the relationship between the capacitance and the charge in the depletion region.  $\Delta C_0$  is obtained from equation (4) by substituting

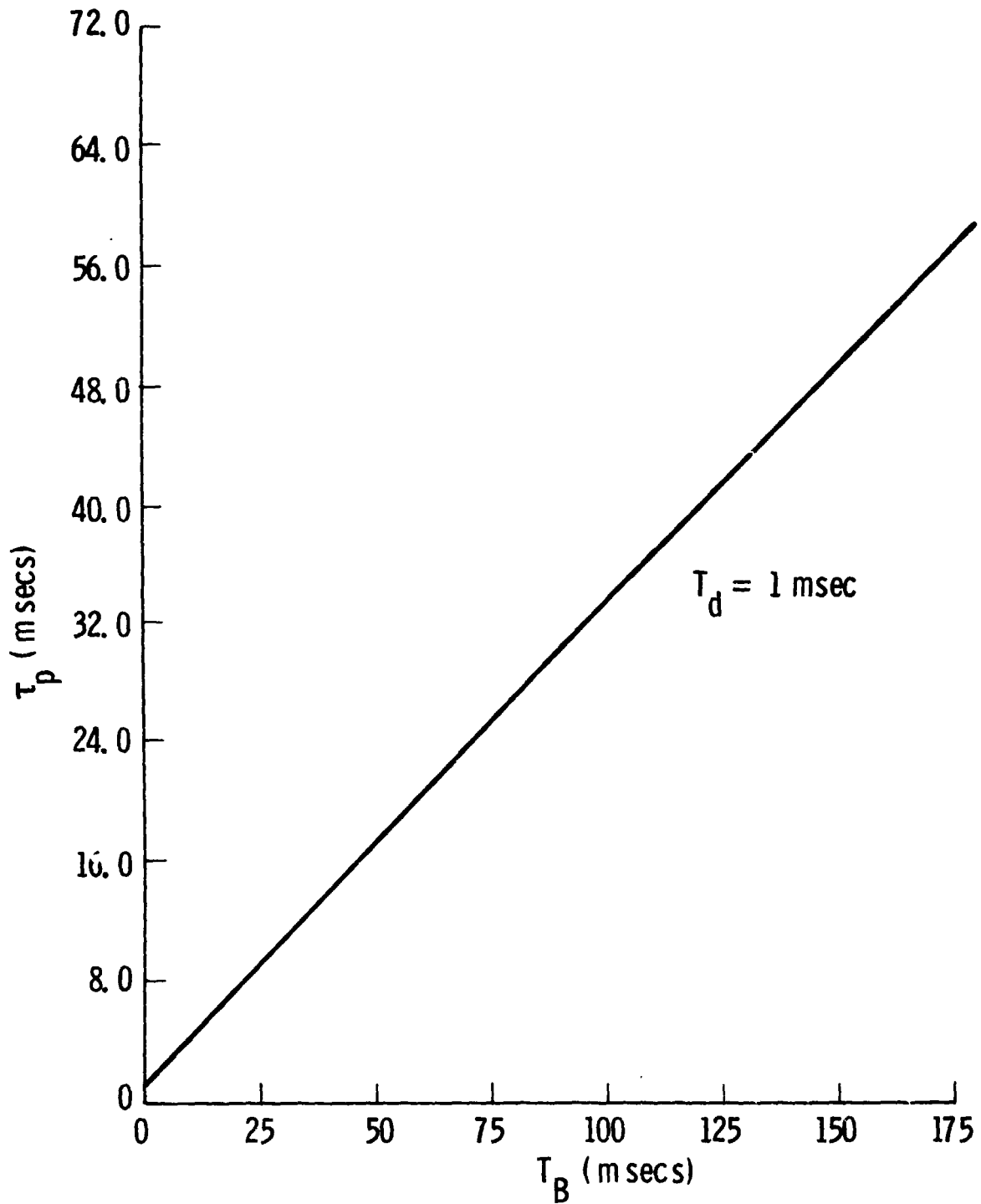


Figure 10 Relationship Between the Parameters  $\tau_p$  and  $T_B$

Curve 718334-B

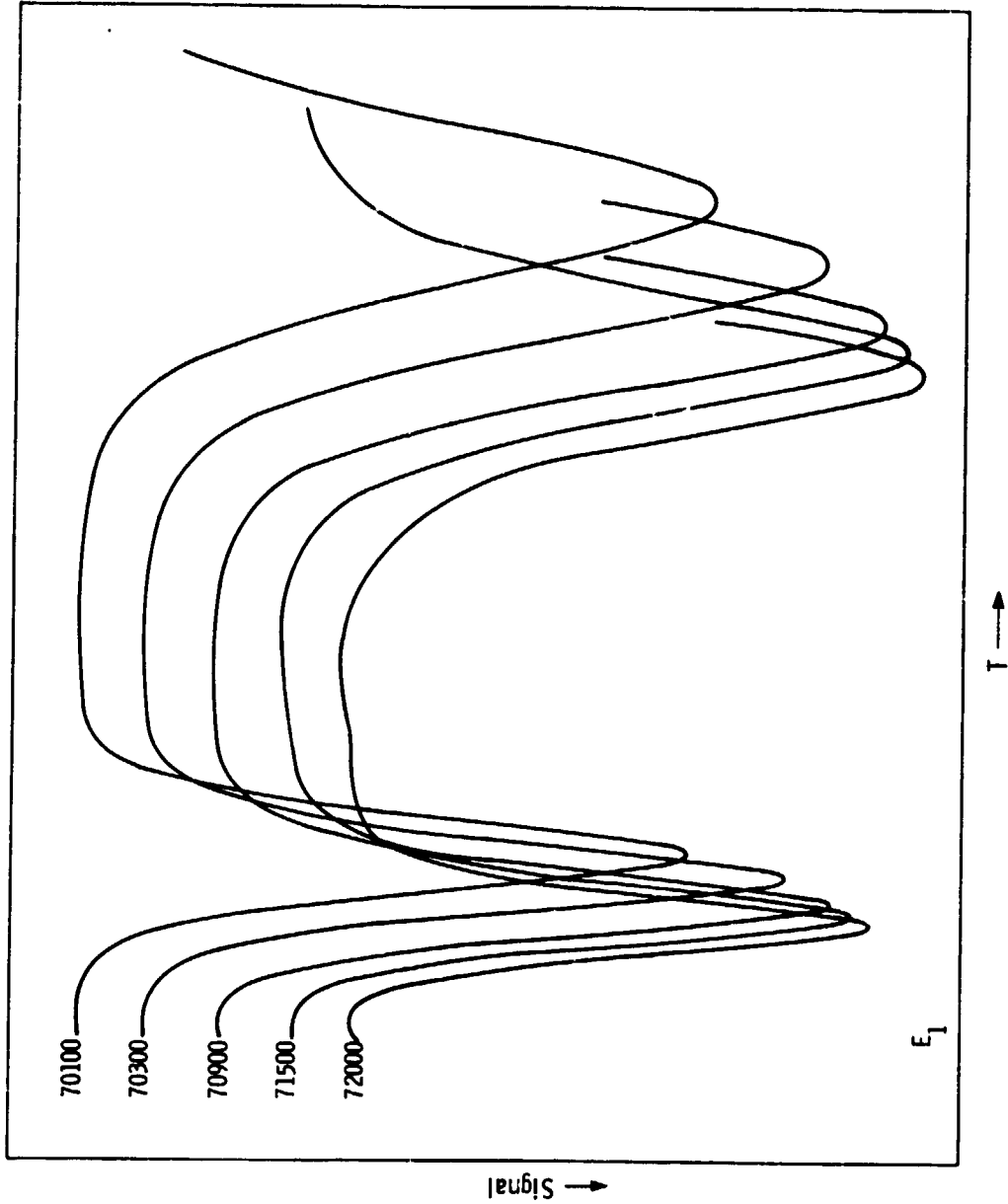


Figure 11 DLTS Spectra for Vanadium Doped N-Type Silicon

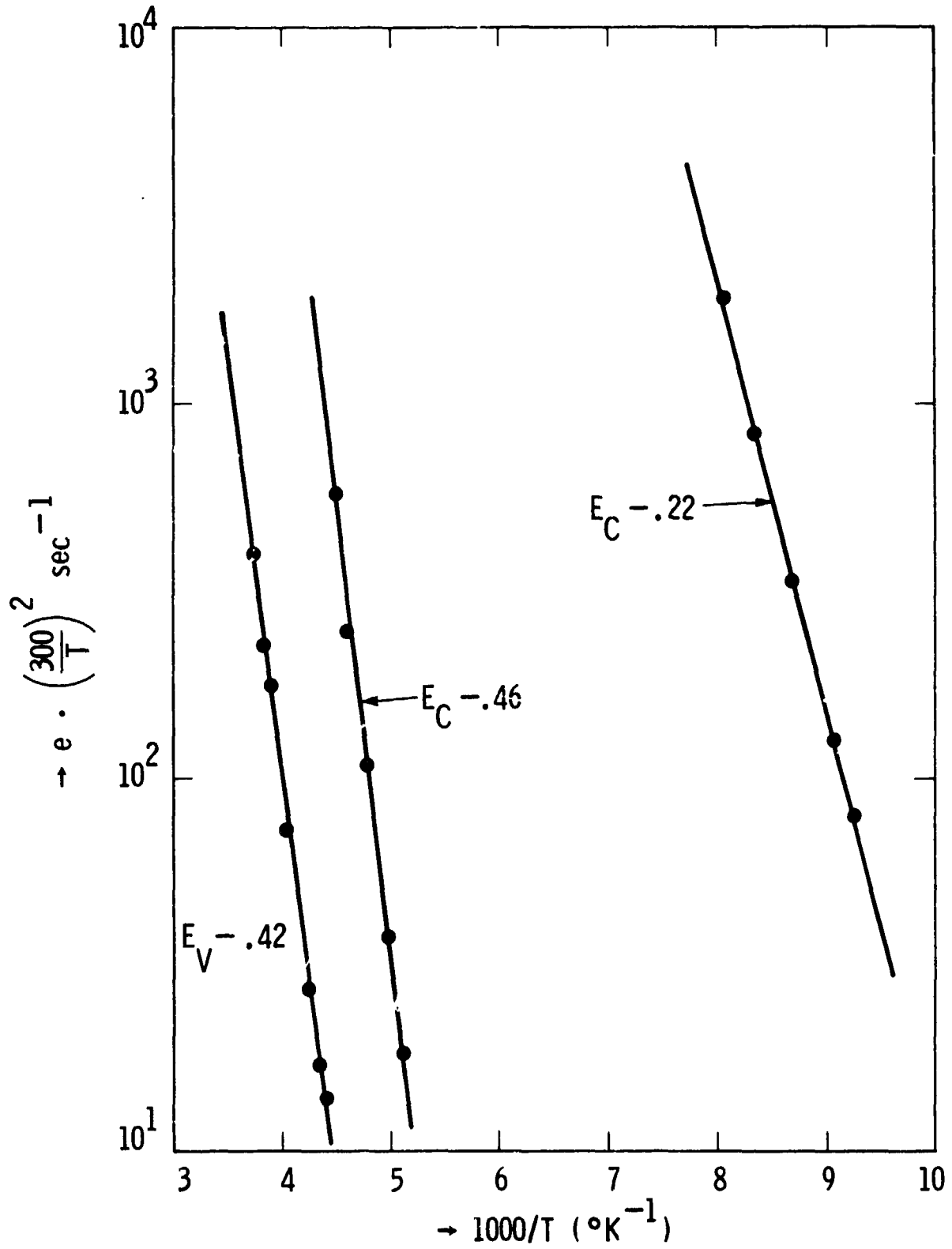


Figure 12 Vanadium-Induced Deep Levels in Silicon

the values of  $\tau_p$ , obtained from the equation (5), and the measured peak height ( $L_{max}$ ). A more general and accurate expression for  $N_T$  is given by<sup>10,11</sup>

$$\delta \left( \frac{\Delta C}{C} \right) = \left( \frac{\epsilon}{qW^2N} \right) \frac{N_T(X)}{N(X)} \delta V \quad (8)$$

where  $\delta \left( \frac{\Delta C}{C} \right)$  is the incremental change in relative capacitance signal when a small change  $\delta V$  is made in the bias pulse of amplitude  $V$ .  $X$  is the depletion width during the bias pulse of amplitude  $V$ , and  $W$  and  $N$  are the depletion layer width and the doping density at the edge of the depletion layer when no bias pulse is applied. Deep levels and trap densities measured on as grown ingots and solar cells studied during the program are compiled in Sections 4.10 and 4.11 respectively.

Capture Rate. The capture process into an initially empty trap is described by<sup>11</sup>

$$N(t) = N_T (1 - e^{-ct}) \quad (9)$$

where  $N(t)$  is the density of traps filled by a bias pulse of width  $t$ .  $N_T$  is the total trap density and  $c$  is the capture rate of the trap.  $N(t)$  values are obtained from the peak heights as the bias pulse width is altered, as shown in Figure 13.  $N_T$  is obtained from the height of the saturating pulse width. The capture rate is obtained from the plot of  $\ln \frac{N_T - N(t)}{N_T}$  versus  $t$ , Figure 14. The capture cross section is determined from the relationship  $c = \sigma N V_{th}$  where  $N$  is the injected carrier density and  $V_{th}$  is the thermal velocity.  $N$  is equal to the doping density for the majority carrier pulse but for the minority carrier injecting pulse it may be difficult to determine. Measured values of majority and minority carrier cross sections for the impurity levels observed in as grown ingots are tabulated in Section 4.12.

\* It should be recognized that while DLTS provides majority carrier capture cross sections, there is no necessary relationship to the minority cross section which controls the solar cell performance. The effective recombination cross sections for minority carriers can be deduced by means of the impurity-performance model as described in Volume 2 of this report.

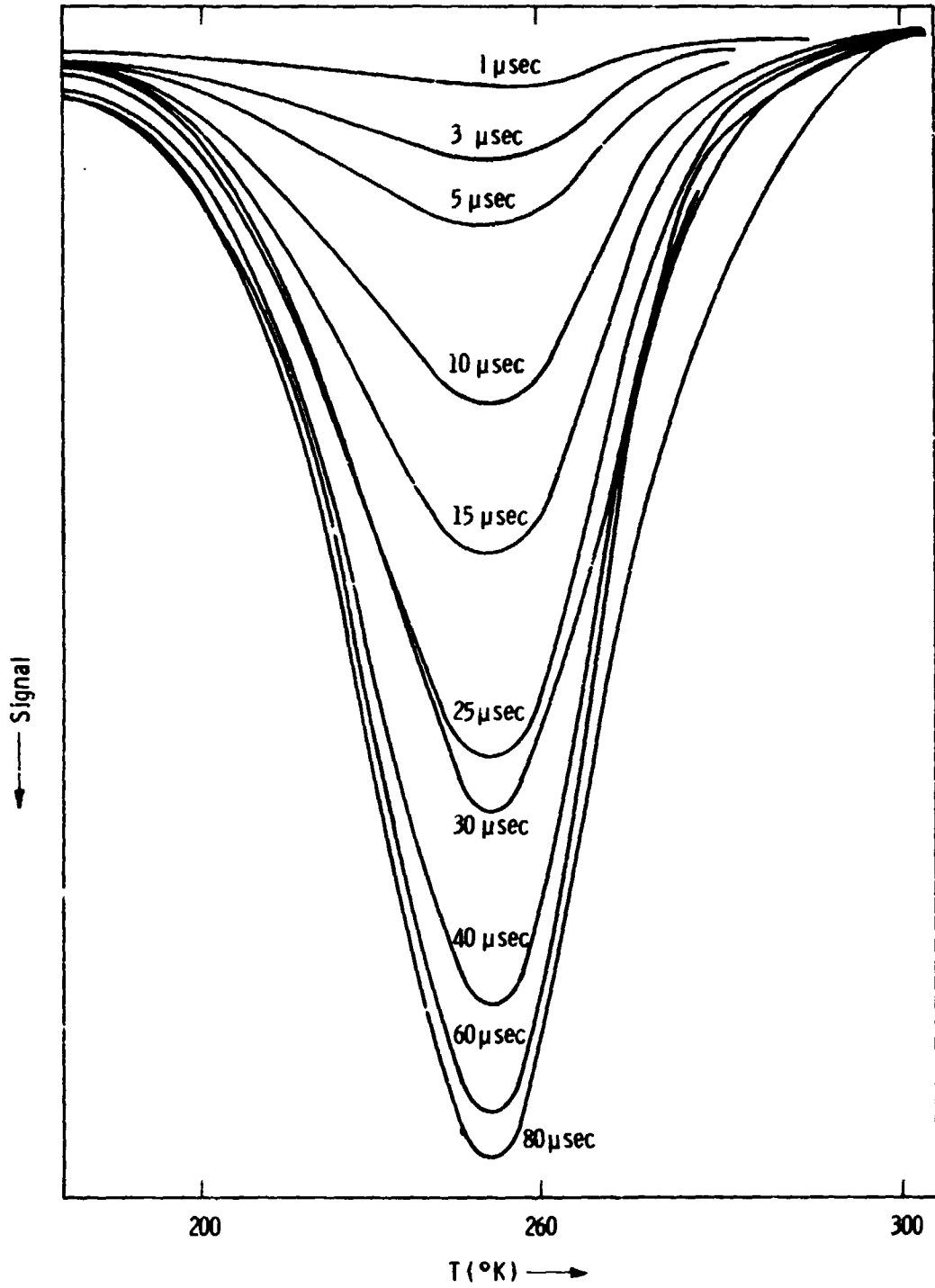


Figure 13 DLTS Signal as . Function of Pulse Width for the  $E_V+0.42\text{eV}$  Trap Induced by V in Silicon

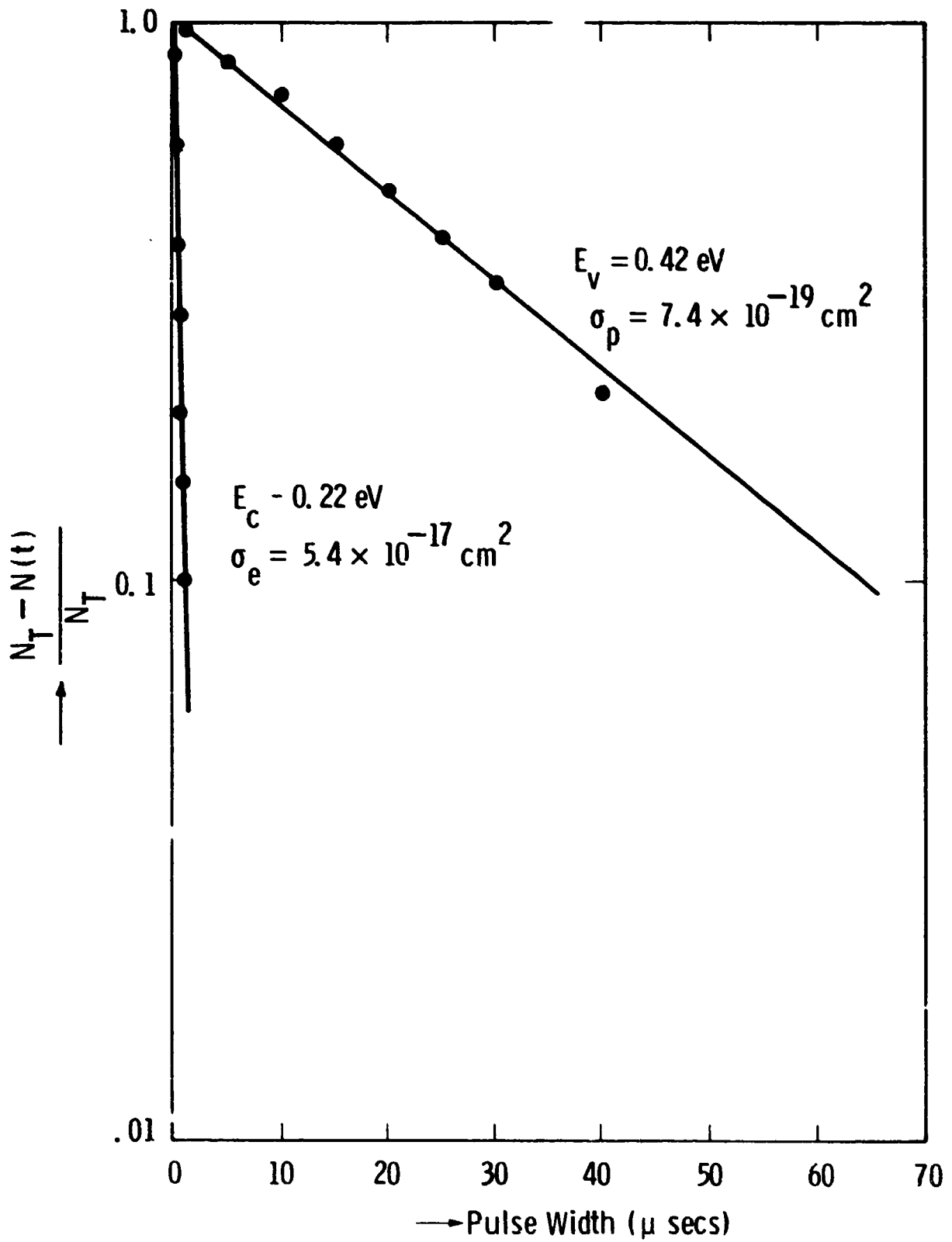


Figure 14

Capture Rates of V-Induced Traps

### 3.3.1.5 Sample Preparation for DLTS

Both as grown ingots and solar cells were evaluated by DLTS. Thirty mil diameter Ti-Si Schottky barrier diodes were fabricated on p type wafers by electron beam evaporation. The 300Å Ti layer was overcoated with 2000Å of Au to form a front contact; the back contact was Ti (1500Å), Pd (500Å), and Ag (20,000Å). On n-base wafers thirty mil Al-Si Schottky barriers were formed by evaporating 1 μm of Al onto the silicon surface followed by a half hour anneal of the wafer at 450°C. in N<sub>2</sub>. The back contact was also a 1 μm thick Al layer.

To analyze the solar cells the front metal contact (Ti-Pd-Ag grid) was removed while the back contact was retained. Ti and Au were then evaporated on the front surface. (Electron beam evaporation was used to evaporate 300Å Ti and then 2000 Å Au on top of it) An array of thirty mil dots was mesa etched using the photoresist technique.

For testing the diodes were mounted on a T05 header (Figure 15). In this way the devices were electrically isolated but were in good thermal contact with the header.

### 3.3.2 Detailed Dark I-V Analysis of Impurity-Doped Solar Cells

Detailed dark I-V analysis has proved a powerful tool for separating and analyzing the effects introduced by impurities in the junction and base regions of the solar cell. This approach is particularly helpful in characterizing the behavior of impurities like Cu, Ni and Fe which produce non linear effects not readily described by our impurity-performance model.<sup>2</sup> An abbreviated description of the method appears in this section; a more detailed account can be reviewed in the last summary report.<sup>2</sup>

Detailed examination of dark I-V data can give reasonably accurate shunt and series resistances, a good estimate of the current losses in the depletion region and in the bulk of the device. In the analysis, the shunt resistance can be approximately determined from a reverse bias measurement<sup>14</sup> at V<sub>R</sub> of 0.5 to 1 volts.

$$R_{sh} = V_R / I_R \quad (10)$$



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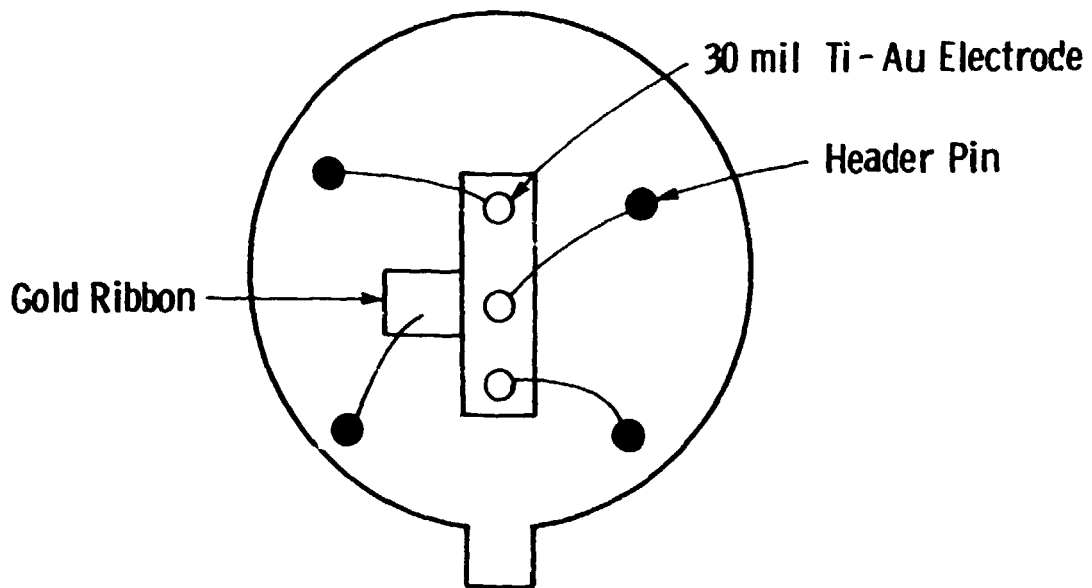
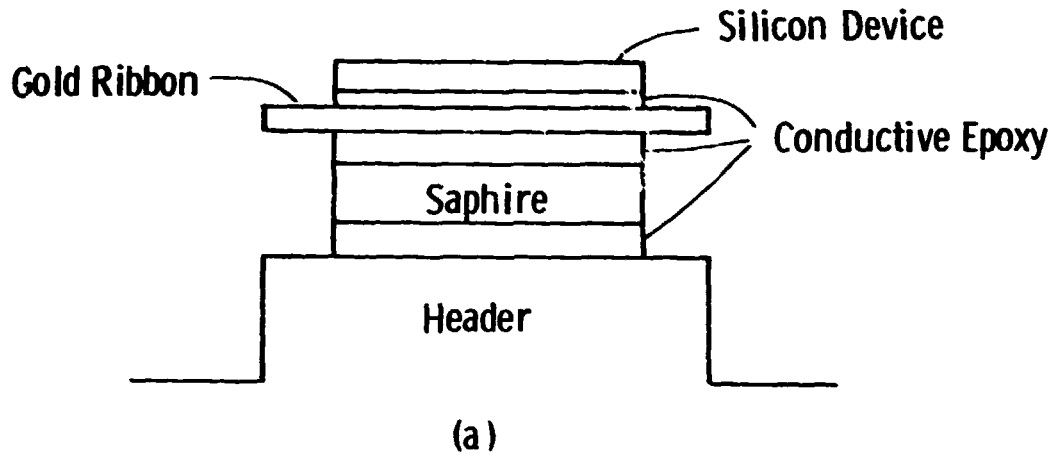


Figure 15 Schematic diagram of the sample arrangement used for DLTS measurements.

The series resistance,  $R_s$ , can be obtained from lighted and dark I-V data. The I-V relationship under illumination can be approximated by

$$V + IR_s = nV_T \cdot \ln [(I_L - I)/I_0 + 1] \quad (11)$$

and in the dark by

$$V - IR_s = nV_T \cdot \ln (I/I_0 + 1) \quad (12)$$

where V and I are the magnitude of terminal voltage and current. Under the open circuit conditions, equation (11) becomes

$$V_{oc} = nV_T \cdot \ln (I_L/I_0 + 1) \quad (13)$$

and in dark if we measure  $V_1$  at  $I = I_L$  equation (12) becomes

$$V_1 - I_L R_s = nV_T \cdot \ln (I_L/I_0 + 1) \quad (14)$$

equations (13) and (14) give

$$R_s = \frac{V_1 - V_{oc}}{I_L} \quad (15)$$

Having determined  $R_{sh}$  and  $R_s$ , their effect can be removed by the following transformations

$$V' = V - IR_s \text{ and } I' = I - I_{sh} \quad (16)$$

The dark characteristics can now be approximated by the sum of two exponential functions, one representing the base controlled current ( $I_b$ ) and other  $I_j$ , associated with the junction depletion region. The base component<sup>16j</sup>,

$$I_b = I_{01} (\exp (V/V_T) - 1) \quad (17)$$

where  $I_{01} = \frac{Aq n_i^2}{N_A} \sqrt{\frac{D_n}{\tau_n}}$  for  $n^+p$  device with wide base. Notice the ideality factor  $n$  is unity in accord with theory<sup>17</sup>.

The junction current

$$I_j = I_{02} (\exp (V/nV_T) - 1) \quad (18)$$

for a recombination center in the middle of the band gap<sup>15,17</sup>  $I_{02} = Aq n_i W_{dep} / 2 \tau_{dep}$  and  $n = 2$ . From the double exponential  $I_b$  and  $I_j$  can be separated numerically or graphically<sup>18</sup> recognizing that below about 0.3 volts the total current,  $I_x$ , is nearly  $I_j$  so  $I_b$  can be obtained by extrapolating  $I_j$  and subtracting it from  $I_x$ .

$$I_b(V) = I_x(V) - I_j(V) \text{ for } V > 0.3 \text{ volts} \quad (19)$$

The operating point of a solar cell lies near 0.5 volts so that a slight displacement of the bulk current component on the log I-V plot can significantly alter cell performance. This shift of the upper segment of the curve to the left reflects a reduction in the bulk carrier lifetime of the material due to the impurity present. In contrast, changes in  $I_j$ , characterized by an upward displacement of the lower segment of the I-V curve, must be considerably greater to produce an affect on cell performance comparable to  $I_b$ .

The features described in the foregoing discussion are illustrated well in Figure 16, transformed I-V curves for solar cells purposely contaminated with Fe. At lower concentrations ( $9 \times 10^{14} \text{ cm}^{-3}$ ) Fe reduces bulk lifetime, displacing the upper I-V segment relative to that of the uncontaminated baseline cell. As more Fe ( $1.5 \times 10^{15} \text{ cm}^{-3}$ ) is added to the silicon, precipitates form in the junction region of the device; the junction current increases and a considerable upward shift in the lower segment of the I-V curve takes place.

Transformed I-V plots, consisting of  $I_b$  and  $I_j$ , have been used to examine impurity effects on the junction and the bulk regions of many of the devices we have studied. A description of the results forms part of Volume 2 of the report.

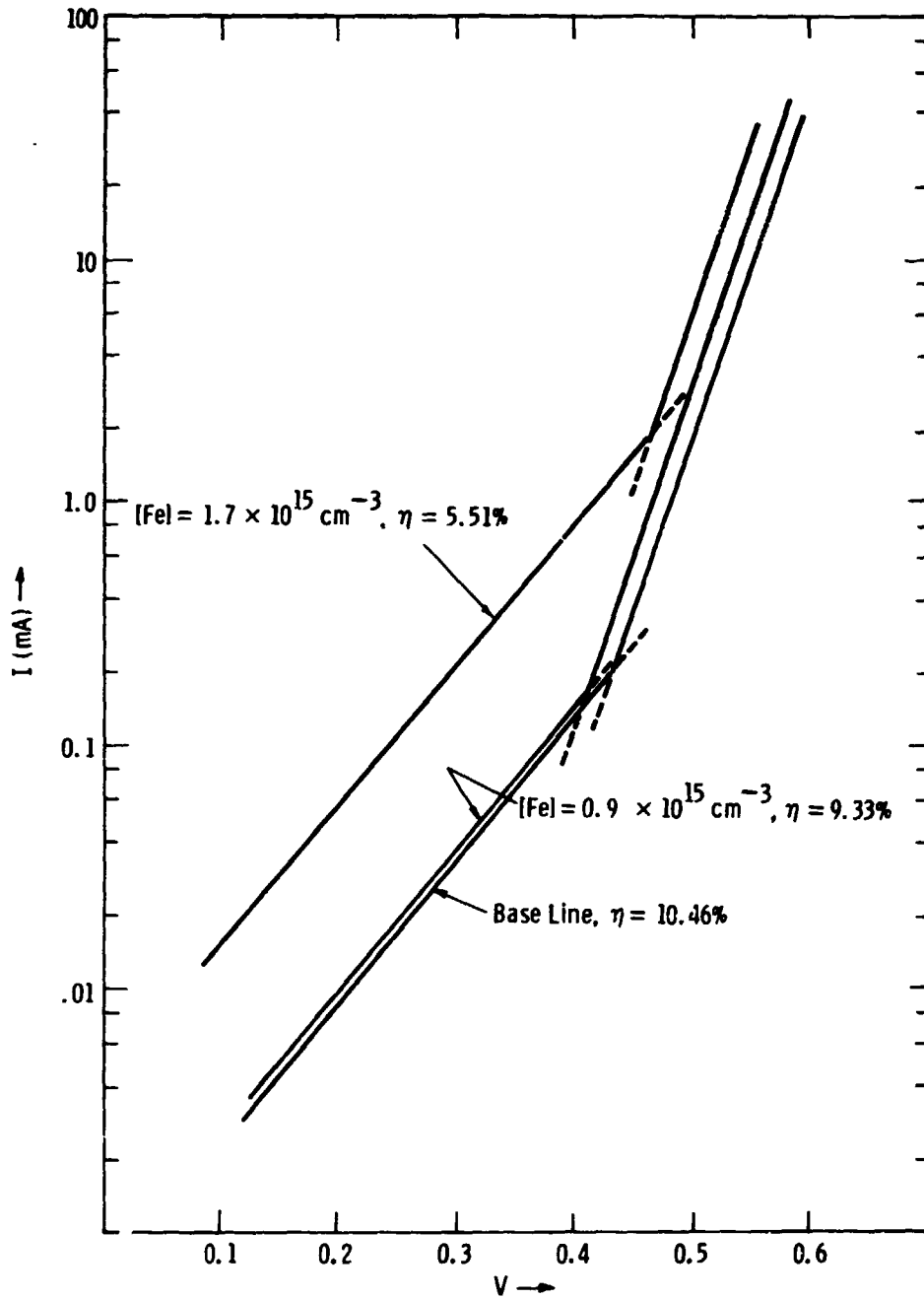


Figure 16 Transformed Dark I-V Curves for Fe-Doped 4 Ω-cm Silicon Solar Cells

### 3.3.3 Spectral Response Measurements

Special equipment has been designed and assembled at Westinghouse to facilitate several types of optical measurements on solar cells or their constituents. The equipment includes a tungsten halogen light source, monochromator and silicon photodetector to provide measurements of reflectivity and photoresponse over the silicon photosensitive wavelength range from less than 0.4 micron to greater than 1.1 micron. The use of a galvanometer driven mirror to deflect the monochromatic light beam into various optical channels allows great flexibility in application of the equipment. In its reflectometer mode, the direct and specimen-reflected beams are compared automatically and ratioed in an analog multiplier to give a direct readout of reflectivity as a function of wavelength. In the spectral response mode, photocurrent from a photosensitive specimen is compared automatically to that from a standard detector of calibrated spectral response.

The equipment has been used to measure and compare changes in the spectral response of silicon solar cells as a function of impurity content and wafer substructure, especially for Ti-doped single crystal and polycrystalline material.

### 3.3.4 Laser Scanned Photoresponse Characterization

Laser spot scanner apparatus has been assembled at the Westinghouse R&D Center to study a variety of solar cells as well as other photosensitive devices. The equipment consists essentially of a laser source and a pair of galvanometer-driven deflection mirrors capable of providing a raster scan of the focused laser beam over a convenient field of view. For the main optics a conventional microscope is used, providing the standard resolution available in such systems, i.e., down to the micron level. Figure 17a shows the light spot scanner, with the He-Ne (6330A wavelength<sup>\*</sup>) low power laser, scanning mirrors, optical microscope, and auxiliary optics. Figure 17b is a schematic of the optical arrangement.

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\* In silicon, light of this wavelength penetrates about 2  $\mu\text{m}$ .

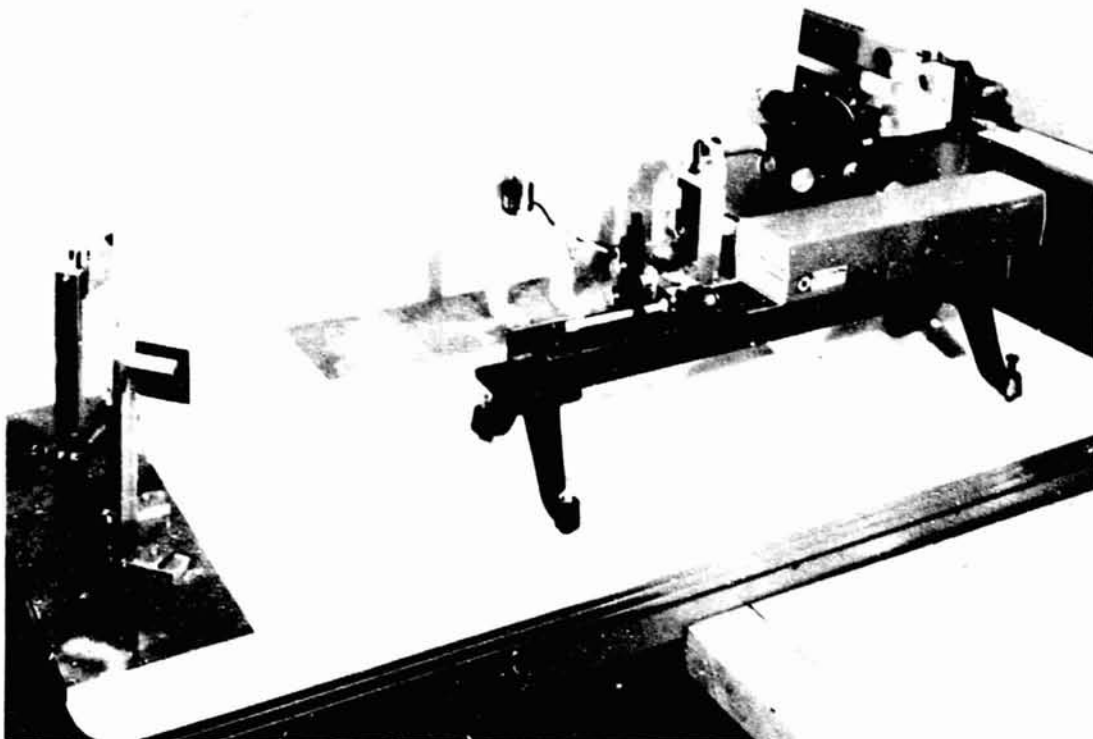


Figure 17a Helium neon laser. Equipment consists of an optical bench with mirrors, two galvanometer driven scan mirrors (center) which sweep laser beam in a raster pattern through the microscope (right) where it is imaged in a 2  $\mu\text{m}$  spot on the surface of a cell inserted into the holder mounted on an X-Y micro-manipulator stage.

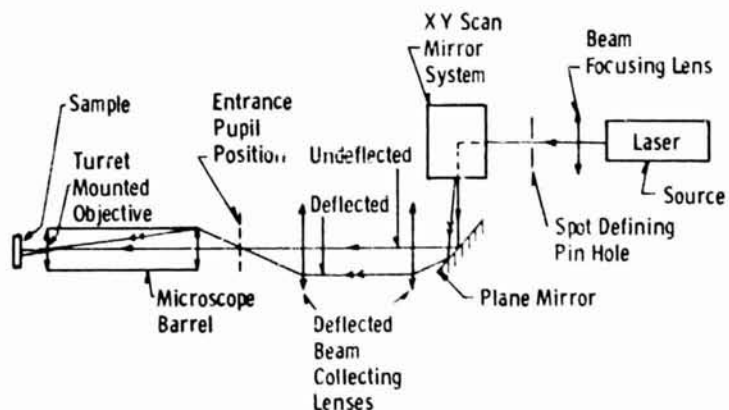


Figure 17b Diagram of the optics of the Westinghouse raster scanned light spot system for studying semiconductor devices.

The display usually consists of a TV type image on a CRT, with the video information provided by transducing as necessary any of several inputs, such as light reflected from the specimen, light transmitted through the specimen, and photocurrent, if any, induced in the specimen. The first two modes provide images of the type that would be obtained in a conventional optical microscope. These are useful as location references for the main use of the system, which is under the third mode. For quantitative data on reflection, transmission or photocurrent, single line traces of signals proportional to these quantities can also be displayed.

This equipment has proven very valuable in the study of impurity-grain boundary interactions in polycrystalline solar cells by allowing quantitative assessment of suppressed photocurrent collection in the vicinity of grain boundaries.

### 3.3.5 Recombination Lifetime Measurements

#### 3.3.5.1 Photoconductive Decay (PCD) Lifetime Determination

PCD measurements require only low temperature specimen preparation and correlate well with solar cell performance.<sup>1</sup> Thus we have used the technique extensively to track the response of impurity-doped silicon to various thermal and gettering treatments and to compare the properties of as-grown and diffused wafers.<sup>2</sup> Initially we used an LPE GaAs IR emitting diode as the pulsed light source for measurements.<sup>1</sup> That approach suffered from the relatively high absorption of the 0.94  $\mu\text{m}$  radiation in silicon, the low radiation intensity of the source, and the rather long radiation decay time of the pulse. We replaced the LED with a YAG:Nd laser to facilitate the analysis of low resistivity and low lifetime specimens produced later in the program.<sup>20</sup>

The diagram in Figure 18 depicts the main features of the laser excited PCD apparatus. The monochromatic radiation wavelength is 1.06  $\mu\text{m}$ , a spectral location for which the absorption coefficient,  $\alpha$ , for high purity silicon is  $11.70 \text{ cm}^{-1}$  at 298°K.<sup>4</sup> The 1/e depth for intrinsic silicon is 0.85 mm (34 mils) and the transmitted radiation

after passing through a 10 mil wafer is 75 percent of that at the incident surface. Absorption due to free carriers is small at 1.06  $\mu\text{m}$  and may be neglected for resistivities greater than 0.07 ohm-cm. The absorption coefficient does, however, increase with temperature.

The most recent refinement to the system was an improvement to the trap light to handle a higher density of traps in the silicon.<sup>19</sup> A GE type H7635, 160,000 CP, 50 watt quartz halogen cycle sealed beam lamp was installed to assure that, even for high concentrations of shallow levels, all traps will be filled during the PCD measurement. Radiation from the lamp, collimated by an ellipsoidal reflector is focussed by an  $f = 1$  (f.l. = 15cm) double convex lens onto the silicon sample. A 0.25mm thick silicon wafer filters the incident radiation to reduce sample heating and promote uniform trap filling.

In practice the system was calibrated by measuring the effective bulk lifetime  $\tau_r'$  as a function of thickness for a number of specimens then determining  $S$ , the surface recombination velocity mathematically from a curve fit of the data.<sup>2</sup> Experimental conditions are then chosen to minimize errors from the decay of higher order bulk modes and obtain the correct injection levels. For example, errors due to the electric field will be less than 5% when the field is limited to 1.0 volt/cm. Errors due to injection level will be less than 5% when the injection ratio is limited to  $5 \times 10^{-3}$ . Errors due to the effects of higher modes [ $\tau_r' = (\tau_{1/2} - \tau_{1/4}) / \ln 2$ ] can be kept in the range + 0-50% when the ratio  $(1/\tau)/(1/\tau_{000})$  is greater than 1.0. With the leeway allowed in the electric field and injection level  $\tau_r'$  can be accurately determined after the higher modes have decayed or the signal has decayed to less than 10% of initial signal at  $t = 0$ . From the surface recombination velocity and the measured  $\tau_r'$  reliable values of the bulk recombination lifetime  $\tau_r$  can be derived. For further details reference 20 may be consulted.



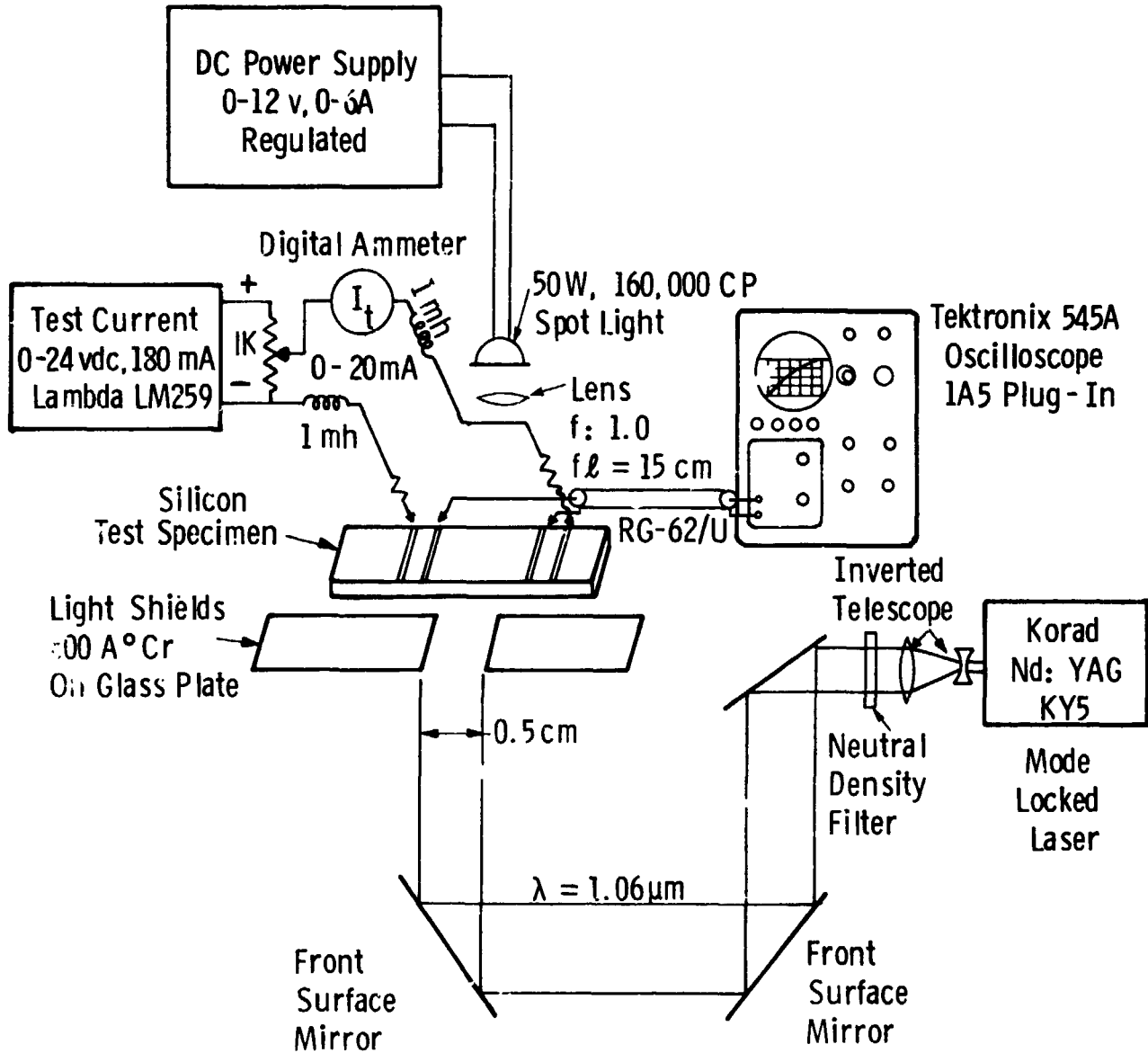


Figure 18 Schematic Diagram of the Laser-Excited Photoconductive Decay Lifetime Measurement Apparatus

PCD lifetime measurements for all the ingots and solar cells evaluated during this program are tabulated in Section 4.13. The format of the data tables has been changed somewhat from that employed earlier.<sup>1,2</sup> Diffusion length as well as bulk recombination lifetime is now listed for most of the specimens, reflecting the fact that diffusion length is the crucial parameter controlling carrier collection. Individual values of standard deviation have been deleted from the tables, the precision of the PCD measurements having been shown to have a probable error of 5.7 percent.<sup>1,2</sup>

#### 3.3.5.2 Open Circuit Decay

In addition to the photovoltaic I-V data collected by the methods described in the next section, measurements were made of minority carrier lifetime in the solar cells themselves. The measurements were made using the open circuit voltage decay method.<sup>1</sup> Data are taken using a Tektronix type-S plug-in. The forward current injection level was set at 20 mA/cm<sup>2</sup> which results in a base carrier concentration approximately equal to that produced by 100 mW/cm<sup>2</sup> illumination. Under these conditions we obtained reliable base lifetime data which were in good agreement with those obtained using the photoconductive decay method.<sup>1</sup>

### 3.4 Solar Cell Measurements

A central purpose of the program is to determine the effects of various impurities and process interactions on solar cell performance. To this end, a solar cell and a number of test structures were designed. The fabrication sequence and cell design were optimized not for high efficiency per se but for ease of processing, reproducibility, and to provide an acceptable diagnostic for characterizing the impurity effects. Coated cell efficiency for uncontaminated baseline devices are, however, about 14% AM1, as noted below.

### 3.4.1 Cell Fabrication

Solar cells were fabricated by two conventional processes.<sup>2</sup> The precleaned wafers were phosphorus diffused at 850°C for 50 minutes for n+p cells; p+n cells were boron diffused at 875°C for 30 minutes. This resulted in a junction depth of 0.35  $\mu\text{m}$  for both n and p-base cells. The corresponding sheet resistances were 60 and 90 ohms/square. The 1.03  $\text{cm}^2$  active area of the cells is defined by a mesa etch, 5 to 8  $\mu\text{m}$  in depth. The front contact grid, a Ti-Pd-Ag metallization, is a five finger pattern, Figure 19, with a 5.4% area coverage. The test structure also includes six van der Pauw patterns for measuring diffused layer sheet resistance; six small test diodes; four small solar cells (0.0576  $\text{cm}^2$  active area); and a test pattern for measuring the specific contact resistance. The master masks were generated and are stored in a computer graphics system which greatly facilitates any needed modifications. The test structure is truncated when used to evaluate rectangular pieces of silicon web, Figure 20.

Contacts were sintered at 550°C for 15 minutes in hydrogen. The average efficiency of base-line cells (no added impurities) was about 10% without anti-reflection coatings. With coatings the average efficiency was 14.1%. The usual experimental run consists of 15 to 25 wafers from the metal-doped ingots along with 5 to 8 uncontaminated baseline wafers.

### 3.4.2 Solar Cell Characterization

Current-voltage measurements were made under illumination from a quartz-iodine (ELH) simulator. The light level was set at 91.6  $\text{mW}/\text{cm}^2$  for the AM1 spectrum based on the calibration of a NASA standard cell (JPL cell no. S/N005). An air-cooled heat sink was used to hold the cell samples; it included a calibrated secondary reference cell with which the light level was checked during each set of measurements. The lighted I-V data were obtained digitally and stored in a computer data base. A number of data reduction programs were used to examine various cell properties. The primary method of analysis was based on the single-exponential model:



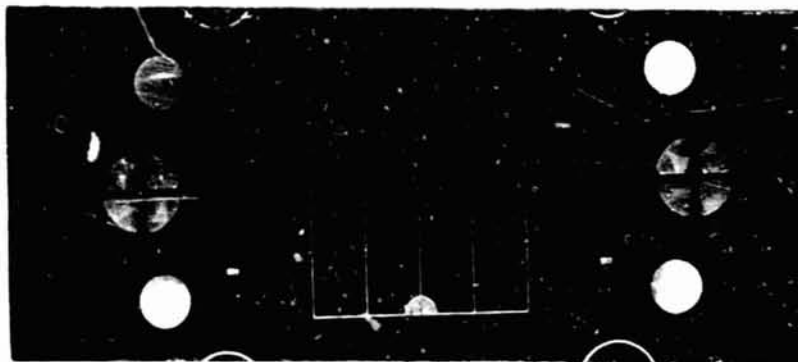
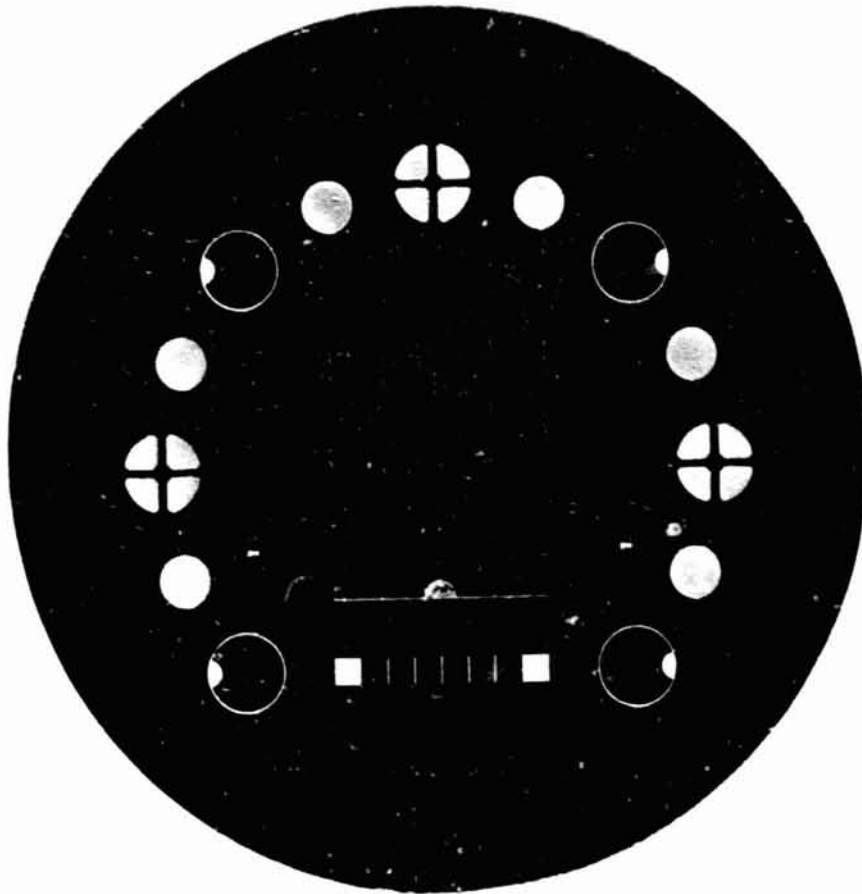


Figure 20 Czochralski and Silicon Web Diagnostic Cells and Test Structures

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$$I = I_{sc} - I_0' [\exp((V + IR_s)/nV_T) - 1] \quad (20)$$

where  $V_T$  is the thermal voltage. The fit gives the parameters  $I_0'$ ,  $R_s$  and  $n$ . The peak power point ( $I_p$ ) was determined by solution of the following condition:

$$dP/dI = I(dV/dI) + V = 0 \quad (21)$$

$V_p$  is obtained from Eq. (20) and the cell efficiency was then determined by:

$$Eff = (V_p \times I_p \times 100) / (91.6 \times A_0) \quad (22)$$

where  $A_0$  is the total area of the cell. The curve fill factor, (FF), is given by:

$$FF = Eff / (V_{oc} I_{sc}) \quad (23)$$

### 3.4.3 Solar Cell Data Base

More than 10,000 devices have been evaluated during the program. The large amount of data gathered has necessitated the use of a computer for data storage, reduction and analysis. A data base system was developed which contains the measured cell data and ingot analysis along with necessary sample and run identifiers. Sufficient coding is provided to permit addressing data by content or by location. An editing program also was developed so data can be modified, corrected or edited.

Data sheets for each impurity-doped ingot, have been printed from the data base. These form the bulk of Section 4.14 where they can be used for ready reference.

#### 4. DATA BASE FOR IMPURITY EFFECTS IN SILICON AND SILICON SOLAR CELLS

##### 4.1 Analysis of Metallurgical Grade Silicon

Listed below are typical concentrations of impurities found in metallurgical grade silicon formed by the carbothermic reduction of silica sand in an arc furnace. The impurities present are mainly transition metals with Al, Fe, Cr, Ca, Ti and V the dominant species. The data are from reference 2, a study conducted by Dow Corning Corporation.

TABLE 4 TYPICAL IMPURITY CONCENTRATIONS IN METALLURGICAL SILICON

<u>Impurity Element</u>	<u>Concentration (ppma)</u>
Al	1300
B	11
Ca	250
Cr	390
Cu	60
Fe	4200
Mg	<5
Mn	120
Ni	100
P	10
Ti	500
V	230
Zr	30

#### 4.2 Residual Impurities in Polycrystalline Silicon

The starting material for all ingots was Dow Corning Semiconductor Grade polycrystalline silicon. A typical analysis of the residual impurities in this material, Table 5 below, shows that the metals are undetectable by spark source mass spectroscopy, and are present at fractions of a part per billion with the exception of Al. At these concentrations the residual impurities have no effect on solar cell performance.

TABLE 5 POLYCRYSTALLINE SILICON ANALYSIS

Analytical Method Impurity	NAA (ppba)	Mass Spec (ppba)	Mass Spec/Freeze Out (ppba)
Cr	$<4 \times 10^{-2}$	<3	~0.01
Cu	$6 \times 10^{-3}$	<20	~0.01
Fe	<2	<30	~0.1
Mn	<1.5	<3	~0.01
Ni	<0.2	<30	ND
Ti	<4	<5	ND
V	--	<3	ND
Zn	--	<5	ND
Zr	--	<12	ND

#### Mass Spec/Freezeout

Al ~ 4.8 ppba;

Carbon 100 ppba - 500 ppba



#### 4.3 Dopants for Controlled Metal Additions to Silicon

The form, purity and melting temperature of each metal used to dope the silicon ingots and web crystals are listed in Table 6. Where possible, four nines purity (or better) grades of metal were chosen, V, Ni and Mo being notable exceptions. In the worse cases trace impurities are expected to be no greater than 1/1000 the concentration of the primary metal dopant.

TABLE 6 CHARACTERISTICS OF DOPANT MATERIALS

<u>Impurity Element</u>	<u>Purity (%)</u>	<u>Form</u>	<u>Melting Point (°C)</u>
Aluminum	99.99	wire	660
Calcium	99.9	block	851
Carbon	99.999	graphite rod	3550
Chromium	99.999	pellets	1900
Cobalt	99.99	polycrystal rod	1555
Copper	99.9997	zone refined ingots	1083
Iron	99.999	sponge	1535
Magnesium	99.99	ingot	651
Manganese	99.99	flake	1244
Molybdenum	99.98	pellets	2610
Nickel	99.98	sponge wire	1455
Niobium	99.99	polycrystal rod	2468

TABLE 6 CHARACTERISTICS OF DOPANT MATERIALS (Cont.)

<u>Impurity Element</u>	<u>Purity (%)</u>	<u>Form</u>	<u>Melting Point (°C)</u>
Palladium	99.99	polycrystal rod	1555
Silver	99.999	polycrystal rod	960.8
Tantalum	99.99	polycrystal rod	2996
Tin	99.9995	polycrystal rod	232
Titanium	99.95	crystal	1668
Tungsten	99.999	polycrystal rod	3410
Vanadium	99.9	dendrite	2190
Zirconium	99.99	foil	2127

#### 4.4 Segregation Coefficients of Metal Impurities During Czochralski Silicon Growth

Listed in Table 7 are our best estimates of the segregation coefficients for elements studied during this program. The effective segregation coefficient is defined as  $k_{\text{eff}} = C_S/C_L$  where  $C_S$  is the impurity concentration in the solid silicon ingot and  $C_L$  is the impurity content of the liquid from which the ingot grew. Values of  $C_S$  are derived from the weighed average of SSMS and NAA analyses of the ingots while  $C_L$  is obtained by atomic absorption or emission spectroscopic analysis of a vacuum cast melt sample (see section 3.2).

The data in Table 7 represent current values of  $k_{\text{eff}}$  for each impurity; some revisions have been made to earlier values as the analytical base has improved.

TABLE 7. Segregation Coefficients

<u>Element</u>	<u>Segregation Coefficient</u>
Al	$3 \times 10^{-2}$ ( $2.8 \times 10^{-3}$ )
B	0.8
C	0.05
Ca	?
Cu	$8.0 \times 10^{-4}$
Cr	$1.1 \times 10^{-5}$
Fe	$6.4 \times 10^{-6}$
Mg	$3.2 \times 10^{-6}$
Mn	$1.3 \times 10^{-5}$
Mo	$4.5 \times 10^{-8}$
Ni	$1.3 \times 10^{-4}$
P	0.35

TABLE 7 Segregation Coefficients

<u>Element</u>	<u>Segregation Coefficient</u>
Ta	$2.1 \times 10^{-8}$
Ti	$2.0 \times 10^{-6}$
V	$4 \times 10^{-6}$
Zn	$10^{-5}$
Zr	$<1.6 \times 10^{-8}$
Co	$2.0 \times 10^{-5}$
W	$1.7 \times 10^{-8}$
Pd	$5 \times 10^{-5}$
Ag	$1.7 \times 10^{-5}$
Sn	0.032
Nb	$<4.4 \times 10^{-7}$

#### 4.5 Resistivity and Defect Density of Czochralski Ingots

Columns one and two of Table 8, show the target and measured values of resistivity for all the ingots grown on this program. A nominal value of 4 to 6  $\Omega$ -cm for p type and 1 to 3  $\Omega$ -cm for n-type material was expected. Most measured resistivities fall in these ranges. A few ingots grown to examine resistivity effects themselves had resistivities in the range 0.1 to 1  $\Omega$ -cm or near 30  $\Omega$ -cm. The third column of the table is the etch pit density obtained by counting the number of pits per unit area on wafers which had been Sirtl etched. Typical wafers made into solar cells exhibited densities less than  $10^3$   $\text{cm}^{-2}$  (wafers taken from the tang ends of ingots often show considerably higher defect densities due to the onset of structural breakdown).

TABLE 8 SUMMARY OF ELECTRICAL AND DEFECT CHARACTERISTICS FOR ALL INGOTS

<u>Ingot Identification</u>	<u>TGT Resistivity (ohm-cm)</u>	<u>Actual Resistivity (ohm-cm)</u>	<u>Etch Pit Density (/cm<sup>2</sup>)</u>
W-001-00-000	4.0 (B)	2.8-3.2	0
W-002-00-000	4.0 (B)	3.0-4.0	0
W-003-00-000	4.0 (B)	3.1-3.6	0
W-004-Cr-001	4.0 (B)	4.6-4.3	0.5-150K <sup>***</sup>
W-005-Mn-001	4.0 (B)	3.6-3.1	0.6-80K
W-006-Ni-001	4.0 (B)	4.1-3.5	0.3-0.96K
W-007-Cu-001	4.0 (B)	5.2-3.7	0-1.2K
W-008-Ti-001	4.0 (B)	4.2-3.1	1.8-150K
W-009-V-001	4.0 (B)	4.1-3.4	0-150K
W-010-Ni-002	4.0 (B)	3.9-3.4	2-46K
W-011-Zr-001	4.0 (B)	4.4-3.6	0.4-9K
W-012-Cr-002	4.0 (B)	4.1-3.9	0.4-100K
W-013-Mn-002	4.0 (B)	4.3-3.2	0.2-150K

TABLE 8 (continued)

W-014-00-000	4.0 (B)	4.3-3.2	1.0-5K
W-015-Zn-001	4.0 (B)	3.9-3.6	0.5-6K
W-016-Fe-001	4.0 (B)	4.6-5.2	0-1.2K
W-017-Cu-002	4.0 (B)	3.8-3.6	2.2-32K
W-018-Fe-002	4.0 (B)	5.9-5.0	0-1.2K
W-019-Cu-003	4.0 (B)	3.8-3.5	0.2-1.5K
W-020-00-000	4.0 (B)	4.0-2.9	0-0.4K
W-021-Mg-001	4.0 (B)	3.8-3.4	0.5-2.5K
W-022-00-000	4.0 (B)	4.1-3.2	0.5-14K
W-023-00-000	0.2 (B)	0.17-0.16	2.5-72.5K
W-024-Mg-002	4.0 (B)	3.8-3.6	3.7-2.5K
W-025-00-000	4.0 (B)	5.1-4.7	2-2.5K
W-026-Mn-003	4.0 (B)	4.5-3.9	1-16.5K
W-027-Mn/Cu-001	4.0 (B)	8.4-6.3	1.25-4K
W-028-Al-001	4.0 (B)	2.9-2.4	0.75-18K
W-029-Cr-003	4.0 (B)	5.2-4.6	0-0.5K
W-030-Cr/Cu-001	4.0 (B)	7.3-6.9	0.5-45K
W-031-Cr/Mn-001	4.0 (B)	8.8-4.7	1.25-Gross Lineage
W-032-Mg-003	4.0 (B)	4.5-4.1	0-10K
W-033-Ti-002	4.0 (B)	4.5-4.2	0-2.5K
W-034-00-000	4.0 (B)	4.4-4.2	0.25-0.5K
W-035-V-002	4.0 (B)	4.4-3.9	1.5-2K
W-036-Zr-002	4.0 (B)	4.4-4.1	0.5-30K
W-037-Zr/Ti-001	4.0 (B)	5.1-4.5	0.5 - Gross Lineage
W-038-Al-002	4.0 (A1)	2.2-1.6	0-0.75K
W-039-Ni-003	4.0 (B)	5.2-4.3	2-30K
W-040-Cr/Ni-001	4.0 (B)	5.3-4.0	1- Gross Lineage
W-041-Ni/Cr/Cu-001	4.0 (B)	5.1-4.7	2-50K
W-042-Ti-003	4.0 (B)	3.8-3.7	1.5-1.5K

TABLE 8 (continued)

W-043-Fe/Ti-001	4.0 (B)	5.7-2.8	0.75-13.5K
W-044-Fe-003	4.0 (B)	3.8-3.8	0-90K
W-045-Cr/Fe/Ti-001	4.0 (B)	5.3-4.3	0.5-15K
W-046-Fe/V-001	4.0 (B)	5.7-5.3	0.5- Gross Lineage
W-047-Cu/Ni/Zr-001	4.0 (B)	4.8-4.4	1.5-5K
W-048-Ti-004	4.0 (B)	4.5-3.8	0.5-40K
W-049-V-003	4.0 (B)	4.4-3.9	0-2K
W-050-Ti/V-001	4.0 (B)	4.6-4.4	0.5-0.5K
W-051-Cu/Ti-001	4.0 (B)	5.0-4.4	0.5-Clusters
W-052-Ni-004	4.0 (B)	4.2-3.8	4K-Gross Lineage
W-053-Poly	4.0 (B)	4.5-4.2	N/A (poly)
W-054-00-000	4.0 (B)	4.3-3.8	0-4.25 K
W-055-Cu-004	4.0 (B)	4.1-3.7	0.5K-25K
W-056-Cu-005	4.0 (B)	4.4-3.75	2.5K-10K
W*-057-00-000	0.5 (B)	0.46-0.47	0.5K - 1.25K
W*-058-00-000	0.2 (B)	0.22-0.18	0-0.2K
W*-059-00-000	0.05 (B)	0.05-0.053	0-2K
W-060-00-000	1.5 (P)	2.1-1.0	0-1K
W-061-Cr/Ti-001	4.0 (B)	5.0-4.0	3 K-Clusters
W-062-N/Cu-001	1.5 (P)	2.0-0.95	0.4-4K
W-063-N/Cr-001	1.5 (P)	2.2-1.7	1K-40K
W-064-N/Mn-001	1.5 (P)	2.2-1.35	1K-3K
W-065-N/Ti-001	1.5 (P)	1.9-1.7	0-2K
W-066-Ti-005	4.0 (B)	6.0-3.9	1K-4K
W-067-Cr/Mn/Ti-001	4.0 (B)	5.5-5.2	1K-4K
W-068-Cr-004	4.0 (B)	5.2-5.1	1K-5K
W-069-Fe-004	4.0 (B)	5.8-5.0	0.4 K- Gross Lineage

TABLE 8. (continued)

W-070-Al-003	4.0 (B)	2.2-1.1	0-1K
W-071-00-000	4.0 (B)	4.1-3.3	1K-4K
W-072-Cr-005	4.0 (B)	5.0-4.5	0-2K
W-073-Cr/Mn/Ni/Ti/V-001	4.0 (B)	5.0-3.8	1K-40K
W-074-Cr/Mn/Ni/Ti/V-002	4.0 (B)	4.4	400-30K
W-075-Ti/V-002	4.0 (B)	4.8-3.9	0-10K
W-076-Poly-002	4.0 (B)	4.8-3.0	N/A (Poly)
W-077-Mo-001	4.0 (B)	4.3-3.8	0-Gross Lineage
W-078-00-000	4.9 (B)	4.3-3.3	0-80K
W-079-00-000	1.5 (P)	2.3-1.1	1K-10K
W-080-Ph-001	4.0 (B)	6.3-3.8	0-5K
W-081-N/Ni-001	1.5 (P)	2.2-1.4	1K-4K
W-082-N/V-001	1.5 (P)	1.8-1.5	0-6K
W-083-N/Fe-Cu1	1.5 (P)	2.1-1.3	1K-Gross Lineage
W-084-N/Al-001	1.5 (P)	7.5-1.9	1K-80K
W-085-N/Zr-001	1.5 (P)	2.4-1.5	1K-20K
W-086-C-001	4.0 (B)	4.0-3.5	0K-20K <sup>+</sup>
W-087-Ca-001	4.0 (B)	3.8-3.4	0 <sup>++</sup>
W*-088-Cr-001	0.2 (B)	0.2-0.18	1K-20K
W*-089-Cu-001	0.2 (B)	0.21-0.19	0-20K
W*-090-Mn-001	0.2 (B)	0.21-0.20	1K-3K
W-091-Cr/Mn-002	4.0 (B)	5.5-3.5	0-Gross Lineage
W-092-Ph-002	4.0 (B)	1.7-5.6	0-1K
W-093-Mn-004	4.0 (B)	4.9-5.3	1K-5K
W-094-Mn-005 (Poly)	4.0 (B)	2.8-4.2	N/A
W-095-Mn-006 (F)	4.0 (B)	4.2-4.9	0-12K
W-096-Mn-007 (S)	4.0 (B)	4.6-4.6	0-2K
W-097-00-000	4.0 (B)	3.2-4.2	0
W-098-Mo-002	4.0 (B)	3.6-4.3	0-10K
W-099-Fz-001	4.0 (B)	4.2-4.4	5K-20K
W-100-Cu/Ti-002	4.0 (B)	3.4-5.2	0-Gross Lineage
W-101-FZ-002	4.0 (B)	4.4-4.9	3K-20K
W-102-Ti-006 (Poly)	4.0 (B)	3.8-6.4	N/A
W*-103-Ti-001	0.2 (B)	0.23-0.25	0-30K
W-104-Cu/Ti-003	4.0 (B)	3.8-4.2	2K-Gross Lineage
W*-105-V-Cu1	0.2 (B)	0.23-0.26	3K-Gross Lineage
W-106-N/Al-002	1.5 (P)	2.1-2.0	0



TABLE 8. (continued)

W-107-Fz/Al-001	2.0 (B)	1.0-2.2	6K-15K
W-108-N/V-002	1.5 (P)	2.3-1.4	0
W-109-C-002	4.0 (B)	4.6-3.6	0-1K
W*-110-Fe-001	0.2 (B)	0.16-0.15	1K
W-111-Cu/V-001	4.0 (B)	4.6-4.3	1K
W-112-Ta-001	4.0 (B)	3.5-2.9	0-Gross Lineage
W-113-Fz/Cr-001	4.0 (B)	5.6-4.9	8K-Twin
W-114-00-000	0.2 (B)	0.19-0.10	0-4K
W-115-N/Cu-002	1.5 (P)	2.2-1.4	2K-10K
W*-116-Ph-001	0.2 (B)	0.44-0.50	0-50K
W-117-00-000	4.0 (B)	4.1-3.7	0-Gross Lineage
W-118-Ph-003	4.0 (B)	1.17 -	0-1K
W-119-N/Fe-002	1.5 (P)	2.1-1.5	1K-Gross Lineage
W-120-N/Cr-002	1.5 (P)	1.9-1.6	0-Gross Lineage
W-121-N/Ti-002	1.5 (P)	2.2-1.4	2K-40K
W-122-Ti-007	4.0 (B)	4.1-4.5	10K-Gross Lineage
W-123-Ti-008	4.0 (B)	2.8-3.6	0-20K
W-124-Mo-003	4.0 (B)	4.1-3.8	0-4K
W-125-Mo-004	4.0 (B)	3.9-3.6	0-Gross Lineage
W-126-Multi-001	4.0 (B)	4.5-3.6	0-Gross Lineage
W-127-Fz/Ti-001	4.0 (B)	7.3-6.2	3K
W-128-Ta-002	4.0 (B)	4.5-3.7	0-3K
W-129-00-000 (7.6 cm)	4.0 (B)	4.7-3.0	1 K-Gross Lineage
W-130-00-000 (7.6 cm)	4.0 (B)	4.7-3.7	0K-Gross Lineage
W-131-Mn-008 (7.6 cm)	4.0 (B)	6.0-3.8	0K-Gross Lineage
W-132-Ta-003	4.0 (B)	3.8-3.4	1-20K
W-133-00-000	4.0 (B)	4.3-3.7	0K-Gross Lineage
W-134-Ti-009	4.0 (B)	4.9-4.4	0-10K
W-135-Fe-005	4.0 (B)	5.3-2.1	0-Gross Lineage
W-136-Fe-006	4.0 (B)	3.3-2.7	1K-Gross Lineage
W-137-Ti-010	4.0 (B)	4.6-4.4	0-Gross Lineage
W-138-Mo-005	4.0 (B)	5.0-4.1	0-5K
W-139-Mo-006	4.0 (B)	4.5-2.3	0-Gross Lineage
W-140-Ti-011 (7.6 cm)	4.0 (B)	3.6-1.7	5K-Gross Lineage
W-141-Mo/Cu-001	4.0 (B)	4.7-3.0	1K-Gross Lineage
W*-142-00-000	0.2 (B)	0.22-0.20	0-3K

TABLE 8. (continued)

W*-143-Ti-002	0.2 (B)	0.21-0.15	0-Gross Poly
W*-144-Mo-001	0.2 (B)	0.23-0.19	0-Gross Poly
W-145-W-001	4 (B)	4.5-4.0	2K-Gross Poly
W-146-Co-001	4 (B)	4.7-4.2	1K-Gross Poly
W-147-N/Ni-002	1.5 (P)	1.9-1.4	2-15K
W-148-N/Mn-002	1.5 (P)	2.5-2.1	1K-Gross Poly
W-149-N/Fe-003	1.5 (P)	2.0-1.6	3K-Gross Poly
W-150-N/V-003	1.5 (P)	2.0-1.5	1-5K
W**-151-00-000	30 (B)	35.6-18.1	0-5K
W**-152-Ti-001	30 (B)	31.9-25	0-Gross Poly
W-153-N/Ti-003	1.5 (P)	2.1-1.1	0-10K
W-154-N/Cr-003	1.5 (P)	2.1-1.4	3K-10K
W-155-N/Mo-001	1.5 (P)	1.9-1.8	1-4K
W-156-N/Mo-002	1.5 (P)	1.7-1.3	3K-Gross Poly
W-157-N/Ti/V-001	1.5 (P)	2.0-1.6	1-10K
W-158-N/Ti/V/Cr-001	1.5 (P)	2.1-1.6	1K-gross Lineage
W-159-N/Cr/Mn/Ti/V-001	1.5 (P)	2.0-1.8	1-2K
W*-160-Ti-001	1.0 (B)	1.3-1.0	2-8K
W**-161-Ti-002	30 (B)	31.8-21.7	1-15K
W-162-Ni/Ti-001	4.0 (B)	4.5-4.0	OK-Clusters
W-163-Ni/V-001	4.0 (B)	4.8-4.4	1K-Clusters
W-164-Ni/Mo-001	4.0 (B)	4.7-3.2	OK-Clusters
W-165-Co-002	4.0 (B)	4.5-3.8	0-5K
W-166-Fe-007	4.0 (B)	4.7-3.0	OK-Gross Lineage
W-167-Nb-001	4.0 (B)	4.0-5.7	OK-Poly
W*-168-Ph-002	0.5 (B)	0.41-0.50	3-10K
W*-169-Ph-004	1.0 (B)	0.9-1.4	OK
W-170-Ph-005	2.9 (B)	1.1-2.5	1-3K
W-171-W-002	4.0 (B)	4.3-4.1	0-2K
W-172-Cu-006 (7.6 cm)	4.0 (B)	3.4-2.7	0-10K
W-173-Fe-008 (7.6 cm)	4.0 (B)	5.9-3.6	3K-Poly
W-174-Ta-004	4.0 (B)	4.3-3.8	OK-Twin
W-175-W-003	4.0 (B)	4.1-3.3	0-10K
W-176-00-000	2.0 (P)	2.0-1.3	OK
W-177-N/Cr/Mn-001	2.0 (P)	2.2-1.4	OK-Poly
W-178-N/Mn/Ti-001	2.0 (P)	2.1-1.7	2K-Poly

TABLE 8. (continued)

W*-179-Ph-006	0.35 (B)	0.3-0.3	0-2K
W*-180-Ti-001	0.5 (B)	0.51-0.49	2-5K
W-181-Cr-006	4.0 (B)	5.4-4.0	OK Clusters
W-182-Cr-007	4.0 (B)	4.2-3.6	0-4K
W-183-Nb-002	4.0 (B)	3.6-2.9	0-5K
W-184-Pd-001	4.0 (B)	4.2-3.9	0-4K
W-185-Cu/Ti-004	4.0 (B)	4.7-4.6	0-Poly
W-186-Co-003	4.0 (B)	4.1-3.7	0-2K
W-187-Co-004	4.0 (B)	3.8-2.9	Processing
W-188-W-004	4.0 (B)	4.7-3.5	0-2K
W-189-Nb-003	4.0 (B)	4.0-3.3	2-10K
W-190-Cu/Zr-001	4.0 (B)	4.4-2.9	OK-Gross Lineage
W-191-Cu-Ta-001	4.0 (B)	4.4-3.6	0-10K
W-192-Ag-001	4.0 (B)	5.6-5.2	0-2K
W-193-Sh-001	4.0 (B)	4.3-3.6	0-2K
W-194-Ti-012	4.0 (B)	3.4-2.9	0-1K
W-195-Ti/V-Mo-001	4.0 (B)	3.9-3.2	2-5K
W-196-Ti/V/Mo-Ta-001	4.0 (B)	3.6-3.0	0-2K
W-197-Ti/V/Mo-Ta/Cu-001	4.0 (B)	4.0-3.4	0-2K

\* Low resistivity p-type ingot ( $\leq 1$  ohm-cm)

\*\* Use of double asterisk indicates 30 ohm-cm p-type ingot

\*\*\* This first figure is etch pit density of the seed; second figure etch pit density of extreme tang end of ingot. The first value shown is indicative of dislocation density in slices used for cell fabrication. Structural degradation commonly occurs at the tang end of the most heavily-doped ingots due to constitutional supercooling.

+ Twinning due to high carbon concentration occurred after approximately three inches of crystal growth

++ Multiple crystal growth due probably to CaO formation

#### 4.6 Carbon and Oxygen Analyses of Silicon Ingots

The carbon and oxygen content of selected Czochralski ingots is the subject of Table 9. Infrared absorption measurements were used to obtain the concentration values; for a few low resistivity ingots free carrier absorption precludes using this approach. In general the measured concentrations fall in the ranges expected, and typically found, in crystals grown by the Czochralski technique. In float zoned ingots the carbon and oxygen concentrations fall below detection limits as expected.

Table 9. Carbon and Oxygen Concentrations for Representative Ingots

<u>Ingot Number</u>	<u>Carbon Concentration <math>\times 10^{16}</math> atoms/cm<sup>3</sup></u>	<u>Oxygen Concentration<sub>3</sub> <math>\times 10^{16}</math> atoms/cm<sup>3</sup></u>
W-001-00-000	7.5	94
W-003-00-000	12.5	94
W-005-Mn-001	6	126
W-007-Cu-001	7.5	49
W-009-V-001	18	100
W-011-Zr-001	8	87
W-013-Mn-002	5	160
W-015-Zr-001	9	100
W-017-Cu-002	5.5	78
W-019-Cu-003	4.2	96
W-021-Mg-001	8	110
W-023-00-000	**	**
W-025-00-000	9.6	96
W-027-Mn/Cu-001	<2	110
W-029-Cr-003	2.5	150
W-031-Cr/Mn-001	11	110
W-033-Ti-002	10	100
W-035-V-002	5.1	135
W-037-Zr/Ti-002	8.3	190
W-039-Ni-003	2	170

TABLE 9. (continued)

<u>Ingot Number</u>	<u>Carbon Concentration</u> <u><math>\times 10^{16}</math> atoms/cm<sup>3</sup></u>	<u>Oxygen Concentration</u> <u><math>\times 10^{16}</math> atoms/cm<sup>3</sup></u>
W-041-Ni/Cr/Cu-001	9	115
W-043-Fe/Ti-001	7.3	159
W-045-Cr/Fe/Ti-001	10	118
W-047-Cu/Ni/Zr-001	2.3	140
W-049-V-003	10.3	170
W-051-Cu/Ti-001	6.6	166
W-053-Poly	39	142
W-055-Cu-004	11.3	118
W*-057-00-000	***	***
W*-059-00-000	***	***
W-061-Cr/Ti-001	<2	181
W-063-N/Cu-001	4.4	164
W-065-N/Ti-001	<2	176
W-067-Cr/Mn/Ti-001	<2	226
W-069-Fe-004	<2	146
W-071-00-000	7.6	115
W-073-Cr/Mn/Ni/Ti/V-001	4.2	145
W-075-Ti/V-002	11.6	194
W-077-Mo-001	2.5	134
W-079-00-000	<2	157
W-081-N/Ni-001	5	216
W-083-N/V-001	5.5	136
W-085-N/Zr-001	<2	6
W-087-Ca-001	4.5	69
W*-089-Cu-001	**	**
W-091-Cr/Mn-002	20	111
W-093-Mn-004	7	161
W-095-Mn-005	4.2	151
W-097-00-000	13.2	142
W-099-FZ-001	<2	<5
W-101-FZ-002	<2	<5
W*-103-Ti-001	***	***
W*-105-V-001	***	***
W-107-FZ/Al-001	< 2	< 5
W-109-C-002	< 2 - 14	190 - 44

TABLE 9. (continued)

<u>Ingot Number</u>	<u>Carbon Concentration x 10<sup>16</sup>atoms/cm<sup>3</sup></u>	<u>Oxygen Concentration x 10<sup>16</sup>atoms/cm<sup>3</sup></u>
W-111-Cu/V-001	12.1	86
W-113-FZ/Cr-001	<2	< 5
W-115-N/Cu-002	8.3	112
W-117-00-000	4.9	160
W-119-N/Fe-002	5.0	125
W-121-N/Ti-002	4.7	121
W-123-Ti-008	2.7	137
W-125-Mo-004	8.4	128
W-127-FZ/Ti-002	<2	< 5
W-129-00-000	11.3	202
W-131-Mn-008	5.3	164
W-133-00-000	10.4	117
W-135-Fe-005	9.4	118
W-137-Ti-010	5.3	134
W-139-Mo-006	6.5	149
W-141-Mo/Cu-001	8.3	156
W*0143-Ti-002	***	***
W-145-W-001	5.8	149
W-147-N/Ni-002	14.0	157
W-149-N/Fe-003	6.6	151
W**-151-00-000 (30Ω-cm)	7.0	154
W-153-N/Ti-001	7.5	160
W-155-N/Mo-001	9.2	183
W-157-N/Ti/V-001	5.7	103
W-159-N/Cr-Mn/Ti/V-001	8.7	183
W**-161-Ti-002	6.0	138
W-163-Ni/V-001	5.0	128
W-165-Co-002	11.2	106
W-167-Nb-001	6.0	130
W*-169-Ph-004	14	96
W-171-W-002	10	86
W-173-Fe-008	Incomplete	Incomplete

Table 9. (continued)

<u>Ingot Number</u>	<u>Carbon Concentration x 10<sup>16</sup>atoms/cm<sup>3</sup></u>	<u>Oxygen Concentration x 10<sup>16</sup>atoms/cm<sup>3</sup></u>
W-175-W-003	10	158
W-177-N/Cr/Mn-001	8	150
W*-179-Ph-006	***	***
W-181-Cr-006	8	119
W-183-Nb-002	6	35
W-185-Cu/Ti-004	5	39
W-187-Co/-004	20	164
W-189-Nb-003	13	138
W-191-Cu/Ta-001	12	110
W-193-Sn-001	9.4	200
W-195-Ti/V/Mo-001	32	110
W-197-Ti/V/Mo/Ta/Cu-001	15	130

\* Low resistivity ingot

\*\* High resistivity ingot

\*\*\* Due to free carrier absorption infrared methods cannot be used for carbon and oxygen determination in these samples

#### 4.7 Target and Measured Ingot Impurity Concentrations

The three columns in Table 10 set forth, respectively, the target, calculated and measured values of the impurity concentrations in each ingot grown during the program. The target concentration is the product of the melt concentration (based on the weighed amount of metal and silicon charge weight) and the effective segregation coefficient. The calculated impurity concentration is derived by multiplying the measured melt impurity content (corrected for the amount of crystal grown) by the segregation coefficient. The measured concentrations, column three, are the average value for SSMS measurements and the NAA result (in parenthesis). N/A indicates that no metal impurity was added.

Table 10. Ingot Impurity Concentration

Ingot Identification	Target Concentration <sub>3</sub> 10 <sup>15</sup> atoms/cm	Calculated Concentration <sub>3</sub> 10 <sup>15</sup> atoms/cm	Measured Concentration <sub>3</sub> 10 <sup>15</sup> atoms/cm	
W-001-00-000	N/A	N/A	N/A	
W-002-00-000	N/A	N/A	N/A	
w-003-00-000	N/A	N/A	N/A	
W-004-Cr-001	1.0	0.82	1.0	(<4) <sup>+</sup>
W-005-Mn-001	1.0	0.82	1.35	(0.6)
W-006-Ni-001	3.9	0.66	<0.5	
W-007-Cu-001	2.0	2.36	1.80	(1.65)
W-008-Ti-001	0.20	0.16	0.36	(0.15)
W-009-V-001	0.39	0.46	0.31	
W-010-Ni-002	3.9	2.18	4.0	
W-011-Zr-001	0.0007	0.0019	<0.45	(<0.03)
W-012-Cr-002	0.2	0.18	<0.5	
W-013-Mn-002	0.2	0.15	<0.5	
W-014-00-000	N/A	N/A	N/A	
W-015-Zn-001	1.0	<0.0006	<0.5	
W-016-Fe-001	1.0	0.75	<3.0	(0.90)



TABLE 10 (Continued)

<u>Ingot Identification</u>	<u>Target Concentration <math>10^{15}</math>atoms/cm<sup>3</sup></u>	<u>Calculated Concentration <math>10^{15}</math>atoms/cm<sup>3</sup></u>	<u>Measured Concentration <math>10^{15}</math>atoms/cm<sup>3</sup></u>
W-017-Cu-002	19	13.3	32 (25)
W-018-Fe-002	2	1.6	<3 (1.7)
W-019-Cu-003	0.38	0.53	<0.5
W-020-00-000	N/A	N/A	N/A
W-021-Mg-001	0.003	0.0018	<0.5
W-022-00-000	N/A	N/A	N/A
W-023-00-000	N/A	N/A	N/A
W-024-Mg-002	0.032	0.023	<0.5
W-025-00-000	N/A	N/A	N/A
W-026-Mn-003	0.01	0.0089	<0.5
W-027-Mn/Cu-001	1/1.9	0.73/1.22	1/1.0 (1.1/2.2)
W-028-Al-001	18		26
W-029-Cr-003	0.01	0.0083	<0.5
W-030-Cr/Cu-001	1/1.96	0.82/1.47	1/1.0 (0.5/2.5)
W-031-Cr/Mn-001	1/1	0.85/0.82	1/2.5
W-032-Mg-003	0.32	0.077	0.32
W-033-Ti-002	0.0020	0.0024	<0.3

TABLE 10 (continued)

<u>Ingot Identification</u>	<u>Target Concentration</u> <u>10<sup>15</sup>atoms/cm<sup>3</sup></u>	<u>Calculated Concentration</u> <u>10<sup>15</sup>atoms/cm<sup>3</sup></u>	<u>Measured Concentration</u> <u>10<sup>15</sup>atoms/cm<sup>3</sup></u>
W-034-00-000	N/A	N/A	N/A
W-035-V-002	0.004	0.005	<0.2
W-036-Zr-002	0.0014	0.001	<0.45 <(0.03)
W-037-Zr/Ti-001	0.0007/0.22	0.00066/0.20	<0.45/0.30
W-038-Al-002	60	32.5	34
W-039-Ni-003	8	6.6	3.5
W-040-Cr/Ni-001	0.8/3.5	0.73	1.0/3.5
W-041-Ni/Cr/Cu-001	3.0/0.8/1.9	3/0.8/1.7	3.0/1.7/2.3
W-042-Ti-003	0.04	0.02	<0.3
W-043-Fe/Ti-001	0.8/0.033	0.65/0.033	<3/<0.3
W-044-Fe-003	0.02	0.0167	<2.0
W-045-Cr/Fe/Ti-001	0.65/0.5/0.039	0.47/0.37/0.026	(0.26/0.69)<0.07
W-046-Fe/V-001	0.65/0.06	0.37/0.056	N/A
W-047-Cu/Ni/Zr-001	1.9/1/0.00021	2.1/0.47/0.00025	2.5/<1/<1
W-048-Ti-004	0.00020	0.00038	N/A
W-049-V-003	0.00030	0.00078	N/A
W-050-Ti/V-001	0.00020/0.0003	0.0002/0.0041	<0.5/<0.5
W-051-Cu/Ti-001	1.9/0.2	1.62/0.112	4.0/0.36
W-052-Ni-004	10	5.4	4.0
W-053-Poly	N/A	N/A	N/A
W-054-00-000	N/A	N/A	N/A
W-055-Cu-004	0.1	0.06	<1 (0.5)
W-056-Cu-005	60	90	70 (86)
W*-057-00-000	N/A	N/A	N/A
W*-058-00-000	N/A	N/A	N/A
W*-059-00-000	N/A	N/A	N/A
W-060-00-000	N/A	N/A	N/A
W-061-Cr/Ti-001	Cr: 1.1 Ti: 0.011	Cr: 1.0 Ti: 0.009	Cr: 1.0 (1.1) Ti:<1.0 (<2)
W-062-N/Cu-001	2.5	2.0	2.0 (4.7)
W-063-N/Cr-001	0.83	0.88	1.0
W-064-N/Mn-001	1.0	0.64	2.0 (0.6)
W-065-N/Ti-001	0.20	0.17	0.75*** (0.09)
W-066-Ti-005	0.033	0.027	<0.2

TABLE 10. (continued)

Ingot Identification	Target Concentration $10^{15}$ atoms/cm <sup>3</sup>	Calculated Concentration $10^{15}$ atoms/cm <sup>3</sup>	Measured Concentration $10^{15}$ atoms/cm <sup>3</sup>
W-067-Cr/Mn/Ti-001	Cr: 0.44 Mn: 0.50 Ti: 0.0033	Cr: 0.3 Mn: 0.36 Ti: 0.0022	Cr: 0.3 (0.25) Mn: 0.7 (0.66) Ti: <0.2 (<0.2)
W-068-Cr-004	1.0	1.0	1.0 (0.44)
W-069-Fe-004	0.98	0.92	<1.5 (1.1)
W-070-Al-003	50 (4.75)**	20 (1.9)**	100 (3.0)**
W-071-00-000	None	N/A	N/A
W-072-Cr-005	0.4	0.21	0.28
W-073-Cr/Mn/Ni/Ti/V-001	Cr: 0.48 Mn: 0.46 Ni: 2.0 Ti: 0.0024 V: 0.004	Cr: 0.34 Mn: 0.31 Ni: 1.3 Ti: 0.0030 V: 0.007	Cr: 0.28 (0.17) Mn: 0.8 (0.28) Ni: <2.0 (10) Ti: <0.35 (<0.3) V: <0.35
W-074-Cr/Mn/Ni/Ti/V-002	Cr: 0.08 Mn: 0.08 Ni: 0.5 Ti: 0.00033 V: 0.0006	Cr: 0.054 Mn: 0.64 Ni: 0.28 Ti: 0.001 V: 0.0015	Cr: 0.25 Mn: 0.25 Ni: <2.0 Ti: <0.25 V: <0.25
W-075-Ti/V-002	Ti: 0.056 V: 0.1	Ti: 0.042 V: 0.11	Ti: <0.25 V: <0.25
W-076-Poly-002	None	N/A	N/A
W-077-Mo-001	0.0042	0.0027	<0.3 (0.0042)
W-078-00-000	None	N/A	None
W-080-Ph-001	0.6	0.7	0.8 **
W-081-N/Ni-001	2.3	0.65	<2
W-082-N/V-001	0.4	0.475	0.85
W-083-N/Fe-001	1.0	0.86	<1.5 (1.0)
W-084-N/Al-001	50 (4.7)**	22 (2.1)**	40 (<2.5)**
W-085-N/Zr-001	0.0007	0.0005	<0.015 (<0.011)
W-086-C-001	300	N/A	200-300
W-087-Ca-001	1.0	0.13	?
W*-088-Cr-001	0.5	0.62	3.3
W*-089-Cu-001	2.3	2.13	0.8 (2.5)
W*-090-Mn-001	0.7	0.52	2.75 (0.69)
W-091-Cr/Mn-002	Cr: 0.5 Mn: 0.3	0.3 0.3	1.0 2.75 (-/0.5)

TABLE 10. (continued)

Ingot Identification	Target Concentration $10^{15}$ atoms/cm <sup>3</sup>	Calculated Concentration $10^{15}$ atoms/cm <sup>3</sup>	Measured Concentration $10^{15}$ atoms/cm <sup>3</sup>
W-092-Ph-002	28	N/A	27-30 **
W-093-Mn-004	0.66	0.46	2.75 (0.75)
W-094-Mn-005 (Poly)	0.9	0.63	2.75 (1.3) (0.76)
W-095-Mn-006 (F)	0.5	0.42	2.75 (1.0)
W-096-Mn-007 (S)	0.63	0.55	0.25 (0.6)
W-097-00-000	None	N/A	N/A
W-098-Mo-002	0.00092	0.00042	<0.3
W-099-FZ-001	None	N/A	N/A
W-100-Cu/Ti-002	Cu: 1.0 Ti: 0.033	Cu: 1.25 Ti: 0.04	Cu: 0.5 Ti: <0.3
W-101-FZ-002	None	N/A	N/A
W-102-Ti-006 (Poly)	0.11	0.1	0.25
W*-103-Ti-001	0.167	0.13	0.25
W-104-Cu/Ti-003	Cu: 2.0 Ti: 0.14	Cu: 2.2 Ti: 0.08	Cu: 4.0 Ti: 0.25
W*-105-V-001	0.4	0.7	0.85
W-106-N/Al-002	6.6	2.3	8.3 (0.7)**
W-107-FZ/Al-001	30	25	128 (12)**
W-108-N/V-002	0.08	0.098	0.2
W-109-C-002	<20-140	N/A	<20-140
W-110-Fe-001	0.8	0.67	<2.0
W-111-Cu/V-001	2.5/0.3	2.5/0.34	2.6/0.25
W-112-Ta-001	0.004	0.0028	<0.5 (0.00083)
W-113-FZ/Cr-001	0.8	0.48	1.0
W-114-00-000	---	N/A	N/A
W-115-N/Cu-002	10		4.0
W*-116-Ph-001	35	N/A	(100)**
W-117-00-000	--	N/A	N/A
W-118-Ph-003	70	N/A	(140)**
W-119-N/Fe-002	0.3	##	<3
W-120-N/Cr-002	0.3	0.23	1.0
W-121-N/Ti-002	0.039	0.63	<1
W-122-Ti-007	0.084	0.08	<3
W-123-Ti-008	0.105	0.10	<3
W-124-Mo-003	0.000018	0.000018	<0.2
W-125-Mo-004	0.00006	0.00024	<0.2

Table 10. Ingot Impurity Concentration

Ingot Identification	Target Concentration $\times 10^{15}$ atoms/cm <sup>3</sup>	Calculated Concentration $\times 10^{15}$ atoms/cm <sup>3</sup>	Mass Spec. Analysis $\times 10^{15}$ atoms/cm <sup>3</sup>
W-126-Multi-001	#	#	#
W-127-FZ/Ti-001	0.039	0.012	<3
W-128-Ta-002	0.0008	0.0022	<0.5
W-129-00-000 (7.6 cm.)	NA	NA	NA
W-130-00-000 (7.6 cm.)	NA	NA	NA
W-131-Mn-008 (7.6 cm.)	0.6	0.55	0.55
W-132-Ta-003	0.000037	0.00017	<0.5
W-133-00-000	NA	NA	NA
W-134-Ti-009	0.05	0.03	<0.25
W-135-Fe-005	1.0	0.78	<1.5
W-136-Fe-006	0.3	0.24	<1.5
W-137-Ti-010	0.21	0.21	<0.25
W-138-Mo-005	0.001	0.0008	<0.5
W-139-Mo-006	0.0042	0.0054	<0.5 (0.0073)
W-140-Ti-011 (7.6 cm.)	0.1 <sup>a</sup>	0.18	<0.25
W-141-Mo/Cu-001	0.004/4.42	0.003/3.68	<0.5/4.00
W-142-00-000	NA	NA	NA
W-143-Ti-002	0.20	0.17	<0.25
W-144-Mo-001	0.0042	0.0044	<0.5
W-145-W-001	0.00085	0.00072	<0.15 (0.00085)
W-146-Co-001	1.5	1.1	0.55 (3.0)
W-147-N/Ni-002	0.4	0.33	<1.5 (1.3)
W-148-N/Mn-002	0.60	0.76	0.55
W-149-N/Fe-003	0.60	0.58	<1.5 (0.78)
W-150-N/V-003	0.03	0.03	<0.15
W-151-00-000	NA	NA	NA ++
W-152-Ti-001	0.2	0.22	<0.25 ++ (0.12)
W-153-N/Ti-003	0.01	0.017	<0.25
W-154-N/Cr-003	0.55	0.71	0.35 (0.26)
W-155-N/Mo-001	0.001	0.001	<0.50
W-156-N/Mc-00?	0.004	0.003	<0.50
W-157-N/Ti/V-001	Ti: 0.10	0.08	<0.25
	V: 0.10	0.12	<0.15

TABLE 10. (continued)

Ingot Identification	Target Concentration $\times 10^{15}$ atoms/cm <sup>3</sup>	Calculated Concentration $\times 10^{15}$ atoms/cm <sup>3</sup>	Mass Spec. Analysis $\times 10^{15}$ atoms/cm <sup>3</sup>
W-158-N-Ti/V/Cr-001	Ti: 0.05	0.05	<0.25
	V: 0.05	0.05	<0.15
	Cr: 0.60	0.55	0.33
W-159-N/Cr/Mn/Ti/V-001	Cr: 0.4	0.35	0.20
	Mn: 0.4	0.32	0.25
	Ti: 0.02	0.02	<0.25
	V: 0.02	0.02	<0.15
W <sup>*</sup> -160-Ti-001	0.2	0.17	<0.25
W <sup>**</sup> -161-Ti-002	0.02	0.03	<0.2 +
W-162-Ni/Ti-001	Ni: 1.0	1.21	<1.5
	Ti: 0.2	0.16	<0.25
W-163-Ni/V-001	Ni: 1.0	1.01	<1.5
	V: 0.4	0.44	0.15
W-164-Ni/Mo-001	Ni: 1.0	1.23	<1.5
	Mo: 0.004	0.004	<0.5
W-165-Co-002	Co: 0.30	0.29	<0.55
W-166-Fe-007	Fe: 0.9	1.06	<1.5
W-167-Nb-001	0.044	0.044	<0.15
W <sup>*</sup> -168-Ph-002	31	NA	(105)**
W <sup>*</sup> -169-Ph-004	40	NA	(141)**
W-170-Ph-005	56	NA	(150)**
W-171-W-002	0.0015	Incomplete ##	<0.15
W-172-Cu-006 (7.6 cm)	10	32	24
W-173-Fe-008 (7.6 cm)	0.64	0.51	<1.5
W-174-Ta-004	0.00084	0.00093	<0.50
W-175-W-003	0.00027	0.00029	<0.15
W-176-00-000	NA	NA	NA
W-177-N/Cr/Mn-001	Cr: 1.0	1.20	1.0
	Mn: 1.3	1.26	2.7
W-178-N/Mn/Ti-001	Mn: 1.0	0.86	2.8
	Ti: 0.1	0.08	<0.25
W <sup>*</sup> -179-Ph-006	21	NA	(73)**
W <sup>*</sup> -180-Ti-001	0.2	0.13	<0.25
W-181-Cr-006	1.0	1.04	1.0

TABLE 10. (continued)

Ingot Identification	Target Concentration $\times 10^{15}$ atoms/cm <sup>3</sup>	Calculated Concentration $\times 10^{15}$ atoms/cm <sup>3</sup>	Mass Spec. Analysis $\times 10^{15}$ atoms/cm <sup>3</sup>
W-182-Cr-007	0.25	0.37	0.65
W-183-Nb-002	0.009	0.009	<0.15
W-184-Pd-001	6.5	6.4	6.5
W-185-Cu/Ti-004	Cu: 1.7 Ti: 0.2	1.2 0.15	<0.80 <0.25
W-186-Co-003	0.027	0.027	<0.55
W-187-Co-004	0.135	0.14	<0.55
W-188-W-004	0.00014	0.0002	<0.15
W-189-Nb-003	0.002	0.002	<0.15
W-190-Cu/Zr-001	Cu: 2.0 Zr: 0.0014	1.38 0.0012	2.7 <0.6
W-191-Cu/Ta-001	Cu: 2.0 Ta: 0.00084	0.78 0.00068	2.7 <0.5
W-192-Ag-001	2.25	1.91	2.25
W-193-Sn-001	5635	4057	5635
W-194-Ti-012	0.002	0.003	<0.25
W-195-Ti/V/Mo-001	Ti: 0.003 V: 0.003 Mo: 0.0006	0.003 0.003 0.00049	<0.25 <0.15 <0.5
W-196-Ti/V/Mo/Ta-001	Ti: 0.003 V: 0.003 Mo: 0.0006 Ta: 0.0003	0.0033 0.0034 0.00055 0.00055	<0.25 <0.15 <0.5 <0.5
W-197-Ti/V/Mo/Ta/Cu-001	Ti: 0.003 V: 0.003 Mo: 0.0006 Ta: 0.0003 Cu: 2.0	0.004 0.0028 0.00053 0.00051 1.3	<0.25 <0.15 <0.5 <0.5 0.8

\* Low resistivity p-type ingot ( $\leq 1 \Omega\text{-cm}$ ).

++ 30  $\Omega\text{-cm}$  p-type ingot.

\*\* Value based on resistivity measurement.

+ Value in parenthesis based on Neutron Activation Analysis. Value without parentheses based on SSMS.

# See data sheets for 10 impurities

## No melt sample available

\*\*\* High Ti value possibly due to vacuum leak in M.S.

#### 4.8 Best Estimates of Impurity Concentrations in Silicon Ingots

In Table 11 we present the best estimate of the impurity contents of each ingot based on the current total data available. Incorporated in the estimate is the degree of reliability in the effective segregation coefficients. It is the best estimated value which is used in all analyses drawn throughout the rest of the report. For ingots with impurity concentrations so low that no direct measurement was possible, either no value is shown in the table or the upper limit is quoted.

Bearing in mind the reliability of the analytical techniques, the total number of measurements for a given impurity and expected experimental errors we have also estimated the approximate percentage errors in the best estimate values; these are:

Ag+40	Mg+50, -100	V+40
B+15	Mn+25	W+40
C+50	Mo+30	Zn+50, -100
Ca+50, -100	Nb+50, -100	Zr+50, -100
Co+70	Ni+40	
Cu+40	P+15	
Cr+35	Pd+60	
Fe+35	Sn+60	
	Ta+40	
	Ti+30	



TABLE 11. Best Estimate of Impurity Concentrations

<u>Ingot Identification</u>	<u>Best Estimate of Impurity Conc. (<math>10^{15}</math> atoms/cm<sup>3</sup>)</u>
W-001-00-000	--
W-002-00-000	--
W-003-00-000	--
W-004-Cr-001	1.0
W-005-Mn-001	1.3
W-006-Ni-001	1.6
W-007-Cu-001	1.7
W-008-Ti-001	0.20
W-009-V-001	0.4
W-010-Ni-002	16
W-011-Zr-001	<0.0007
W-012-Cr-002	0.20
W-013-Mn-002	0.25
W-014-00-000	--
W-015-Zn-001	<0.001
W-016-Fe-001	0.9
W-017-Cu-002	19
W-018-Fe-002	1.7
W-019-Cu-003	0.4
W-020-00-000	--
W-021-Mg-001	0.003
W-022-00-000	--
W-023-00-000	--
W-024-Mg-002	0.032
W-025-00-000	--
W-026-Mn-003	0.012
W-027-Mn/Cu-001	1.3/1.7
W-028-Al-001	26
W-029-Cr-003	0.012
W-030-Cr/Cu-001	1.0/1.7

Table 11. Best Estimate of Impurity Concentrations (cont)

<u>Ingot Identification</u>	<u>Best Estimate of Impurity Conc. (<math>10^{15}</math> atoms/cm<sup>3</sup>)</u>
W-031-Cr/Mn-001	1.0/1.3
W-032-Mg-003	0.32
W-033-Ti-002	0.002
W-034-00-000	--
W-035-V-002	0.004
W-036-Zr-002	<0.0014
W-037-Zr/Ti-001	<0.0007/0.22
W-038-Al-002	60
W-039-Ni-003	32.8
W-040-Cr/Ni-001	0.8/12.8
W-041-Ni/Cr/Cu-001	12.8/0.8 /1.7
W-042-Ti-003	0.04
W-043-Fe/Ti-001	0.56/0.033
W-044-Fe-003	0.017
W-045-Cr/Fe-Ti-001	0.65/0.43 /0.039
W-046-Fe/V-001	0.57/0.07
W-047-Cu/Ni/Zr-001	1.7/4.7/<0.00021
W-048-Ti-004	0.0002
W-049-V-003	0.0004
W-050-Ti/V-001	0.0002 /0.0004
W-051-Cu/Ti-001	1.7/0.20
W-052-Ni-004	33.6
W-053-Poly	--
W-054-00-000	--
W-055-Cu-004	0.05

Table 11. Best Estimate of Impurity Concentrations (cont.)

<u>Ingot Identification</u>	<u>Best Estimate of Impurity Conc. (<math>10^{15}</math> atoms/cm<sup>3</sup>)</u>
W-056-Cu-005	65
W-057-00-000	--
W-058-00-000	--
W-059-00-000	--
W-060-00-000	--
W-061-Cr/Ti-001	1.0/0.11
W-062-N/Cu-001	2.5
W-063-N/Cr-001	0.8
W-064-N/Mn-001	1.0
W-065-N/Ti-001	0.20
W-066-Ti-005	0.033
W-067-Cr/Mn/Ti-001	0.4 0.5 0.0033
W-068-Cr-004	1.0
W-069-Fe-004	1.0
W-070-Al-003	50
W-071-00-000	--
W-072-Cr-005	0.4
W-073-Cr/Mn/Ni/Ti/V-001	0.4 0.4 8.1 0.0024 0.004
W-074-Cr/Mn/Ni/Ti/V-002	0.08 0.08 2.0 0.00033 0.0006

Table 11 . Best Estimate of Impurity Concentrations (cont.)

<u>Ingot Identification</u>	<u>Best Estimate of Impurity Conc. (<math>10^{15}</math> atoms/cm<sup>3</sup>)</u>
W-075-Ti/V-002	.056 0.1
W-076-Poly-2	--
W-077-Mo-001	0.0042
W-078-00-000	--
W-079-00-000	--
W-080-Ph-001	0.7
W-081-N/Ni-001	6.9
W-082-N/V-001	0.4
W-083-N/Fe-001	1.0
W-084-N/Al-001	50
W-085-N/Zr-001	<0.0007
W-086-C-001	200-400
W-087-Ca-001	?
W*-088-Cr-001	0.5
W*-089-Cu-001	2.0
W*-090-Mn-001	0.7
W-091-Cr/V-002	0.5/0.3
W-092-Ph-002	28
W-093-Mn J04	0.7
W-094-Mn-005/Poly	0.9
W-095-Mn-006 (F)	1.0
W-096-Mn-007 (S)	0.63
W-097-00-000	--
W-098-Mo-002	0.00092
W-099-Fz-001	--

Table 11. Best Estimate of Impurity Concentrations (cont.)

<u>Ingot Identification</u>	<u>Best Estimate of Impurity Conc. (<math>10^{15}</math> atoms/cm<sup>3</sup>)</u>
W-100-Cu/Ti-002	1.0/0.033
W-101-FZ-002	--
W-102-Ti-006/Poly	0.11
W*-103-Ti-001	0.167
W-104-Cu/Ti-003	2.0/0.14
W*-105-V-001	0.4
W-106-N/Al-002	10
W-107-FZ/Al-001	30
W-108-N/V-002	0.08
W-109-C-002	<20-140
W*-110-Fe-001	0.8
W-111-Cu/V-001	2.5/0.3
W-112-Ta-001	0.00083
W-113-FZ/Cr-001	0.8
W-114-00-200	--
W-115-N/Cu-002	10
W*-116-Ph-001	100
W-117-00-000	--
W-118-Ph-003	140
W-119-N/Fe-002	0.3
W-120-N/Cr-002	0.3
W-121-N/Ti-002	0.039
W-122-Ti-007 (F)	0.089
W-123-Ti-008 (S)	0.105

Table 11. Best Estimate of Impurity Concentrations (cont.)

<u>Ingot Identification</u>	<u>Best Estimate of Impurity Conc. (<math>10^{15}</math> atoms/cm<sup>3</sup>)</u>
W-124-Mo-003	0.000018
W-125-Mo-004	0.0003
W-126-Multi-001	See Data Sheet
W-127-FZ/Ti-001	0.039
W-128-Ta-002	0.000168
W-129-00-000 (7.6 cm)	NA
W-130-00-000 (7.6 cm)	NA
W-131-Mn-008 (7.6 cm)	0.55
W-132-Ta-003	0.000042
W-133-00-000	NA
W-134-Ti-009	0.03
W-135-Fe-005	0.78
W-136-Fe-006	0.24
W-137-Ti-010	0.21
W-138-Mo-005	0.001
W-139-Mo-006	0.0042
W-140-Ti-001 (7.6 cm)	0.18
W-141-Mo/Cu-001	0.004 /4.4
W*-142-00-000	NA
W*-143-Ti-002	0.20
W-144-Mo-001	0.004
W-145-W-001	0.00085
W-146-Co-001	3.0
W-147-N/Ni-002	1.6
W-148-N/Mn-002	0.60

Table 11. Best Estimate of Impurity Concentrations (cont.)

<u>Ingot Identification</u>	<u>Best Estimate of Impurity Concentration (X10<sup>15</sup> atoms/cm<sup>3</sup>)</u>
W-149-N/Fe-003	0.60
W-150-N/V-003	0.03
W**-151-00-000	NA
W**-152-Ti-001	0.21
W-153-N/Ti-003	0.013
W-154-N/Cr-003	0.5
W-155-N/Mo-001	0.001
W-156-N/Mo-002	0.004
W-157-N/Ti/V-001	0.08/0.12
W-158-N/Ti/V/Cr-001	0.05/0.05/0.55
W-159-N/Cr/Mn/Ti/V-001	0.35/0.36/0.02/0.02
W*-160-Ti-001	0.17
W**-161-Ti-002	0.03
W-162-Ni/Ti-001	4.0/0.16
W-163-Ni/V-001	4.0/0.44
W-164-Ni/Mo-001	4.0/0.004
W-165-Co-002	0.6
W-166-Fe-007	1.06
W-167-Nb-001	<0.01
W*-168-Ph-002	110+
W*-169-Ph-004	136+
W-170-Ph-005	150+
W-171-W-002	0.0015
W-172-Cu-006 (7.6 cm)	24.0
W-173-Fe-008 (7.6 cm)	0.51
W-174-Ta-004	0.00084
W-175-W-003	0.00027

Table 11. Best Estimate of Impurity Concentrations (cont.)

<u>Ingot Identification</u>	<u>Best Estimate of Impurity Concentrations (<math>\times 10^{15}</math> atoms/cm<sup>3</sup>)</u>
W-176-00-000	NA
W-177-N/Cr/Mn-001	1.20/1.26
W-178-N/Mn/Ti-001	0.86/0.08
W*-179-Ph-006	NA
W*-180-Ti-001	0.13
W-181-Cr-006	1.04
W-182-Cr-007	0.45
W-183-Nb-002	<0.002
W-184-Pd-001	6.5
W-185-Cu/Ti-004	Cu: 1.2 Ti: 0.16
W-186-Co-003	0.054
W-187-Co-004	0.28
W-188-W-004	0.0002
W-189-Nb-003	<0.0003
W-190-Cu/Zr-001	Cu: 2.0 Zr: <0.0012
W-191-Cu/Ta-001	Cu: 2.0 Ta: 0.00068
W-192-Ag-001	2.20
W-193-Sn-001	4846
W-194-Ti-012	0.003
W-195-Ti/V/Mo-001	Ti: 0.003 V: 0.003 Mo: 0.0006
W-196-Ti/V-Mo-Ta-001	Ti: 0.003 V: 0.003 Mo: 0.0006 Ta: 0.0003



Table 11. Best Estimate of Impurity Concentrations (cont.)

<u>Ingot Identification</u>	<u>Best Estimate of Impurity Concentrations (<math>\times 10^{15}</math> atoms/cm<sup>3</sup>)</u>
W-197-Ti/V/Mo/Ta/Cu-001	Ti: 0.003 V : 0.003 Mo: 0.0006 Ta: 0.0003 Cu: 2.0

\* Asterisk indicates low resistivity p-type ingot ( $\leq 1$  ohm-cm)

\*\* 30 ohm-cm o-type ingot

+ Value based on resistivity measurement

#### 4.9 DLTS Spectra for Selected Impurities

In Figures 21 through 26 are depicted typical DLTS impurity spectra for a number of the major metal contaminants introduced into silicon.

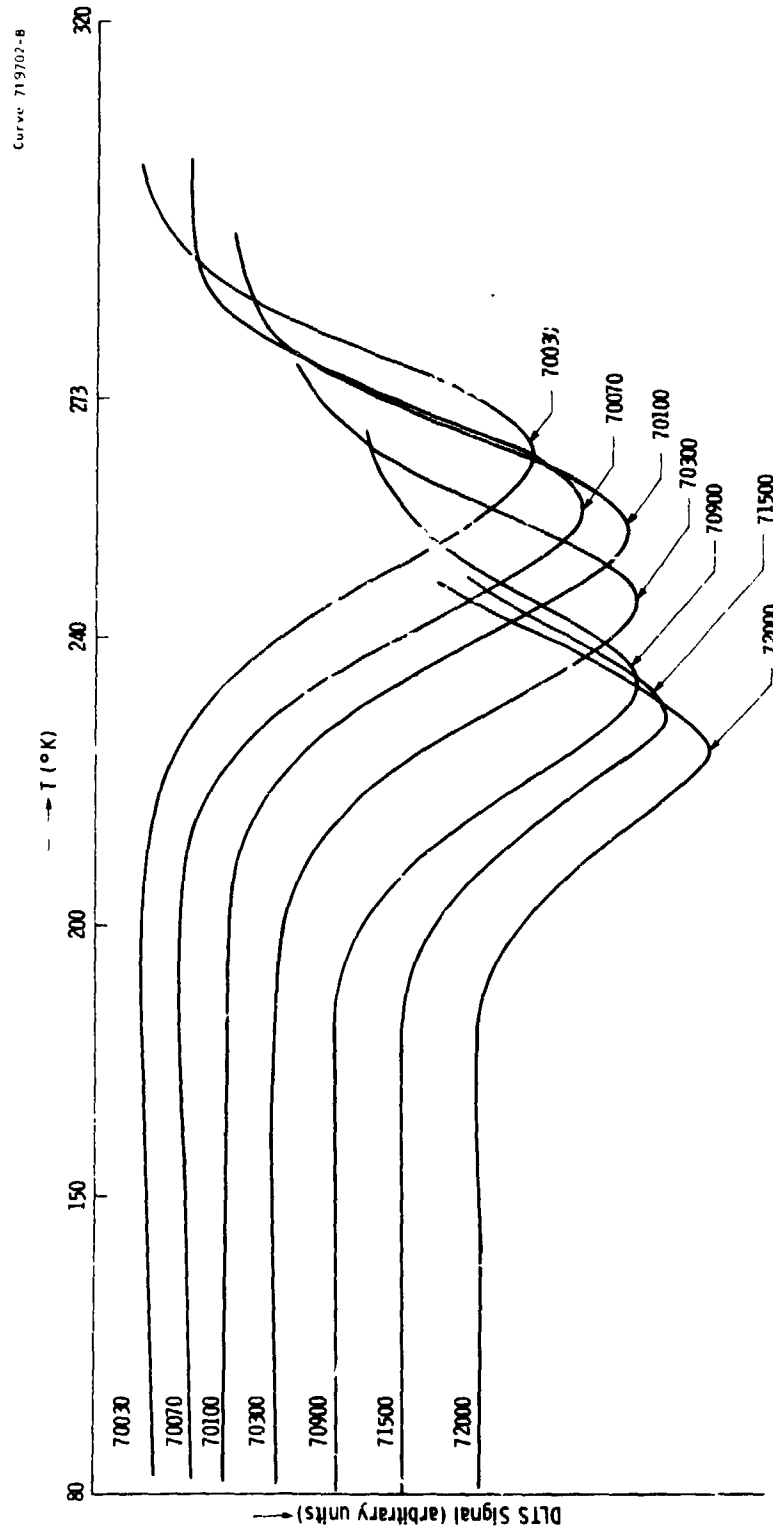


Fig. 1 DLTS Spectra for V-Induced  $E_V + 0.42$  eV Trap (Ingot-09)

Curve 719697-B

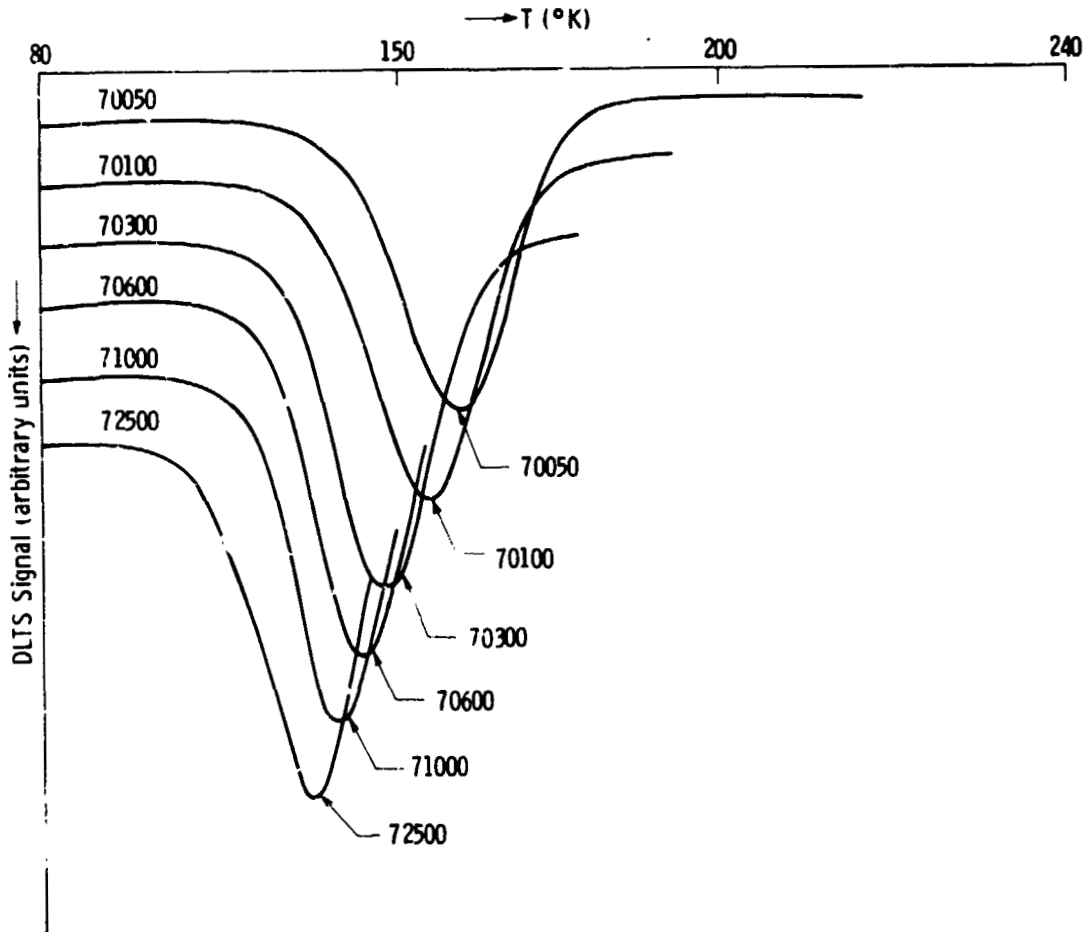


Figure 22 DLTS Spectra of Ti-Induced  $E_C - 0.26$  eV Trap (Ingot-121)

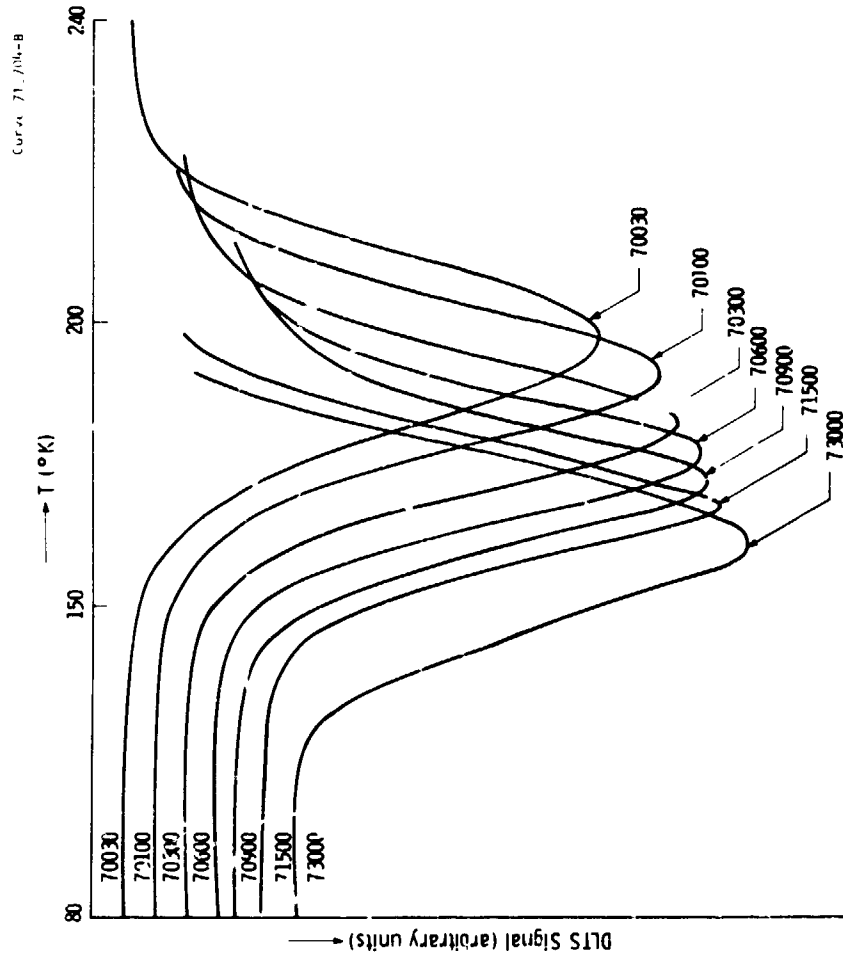


Figure 23 DLTS Spectra for Ti-Induced  $E_V + 0.30$  eV Trap (Inzct-137)

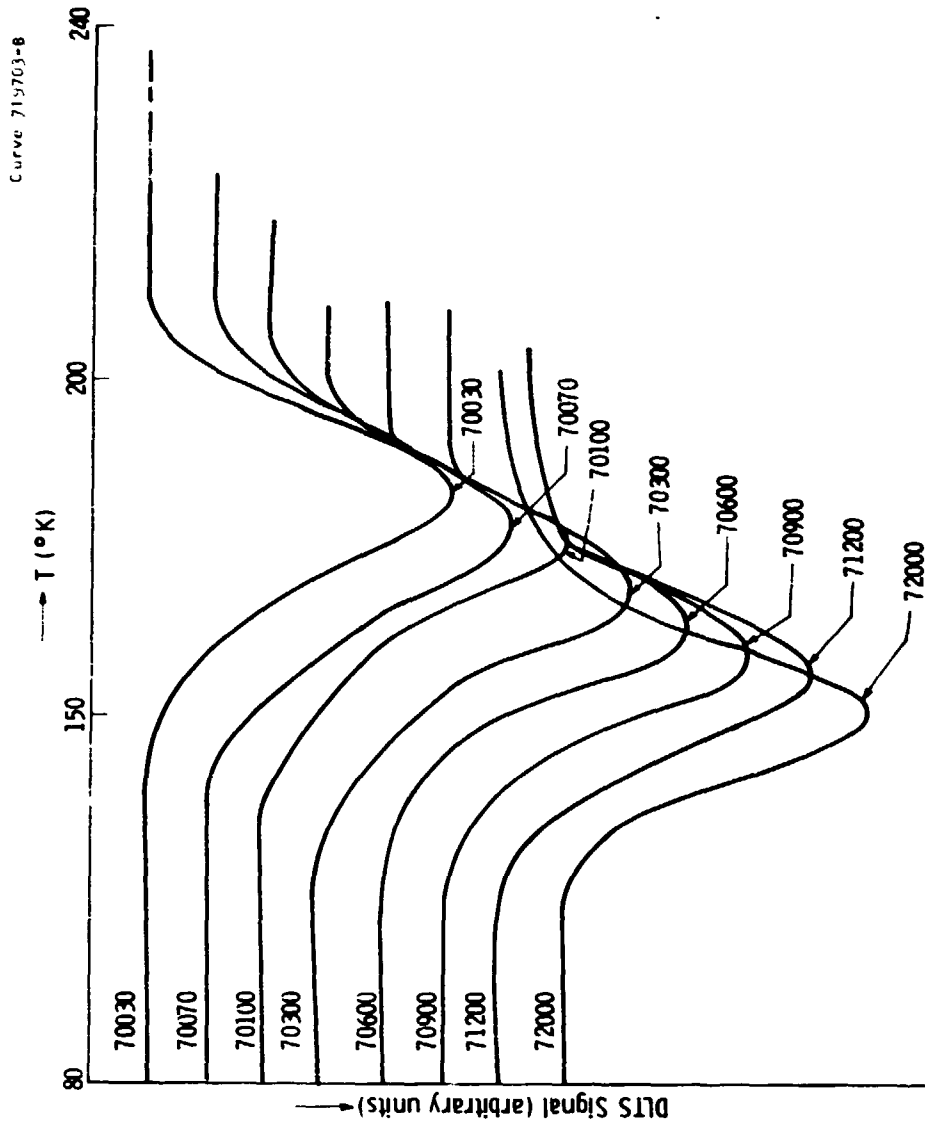


Figure 24 DLTS Spectra for Mo-Induced  $E_V + 0.30$  eV Trap (Ingot-77)

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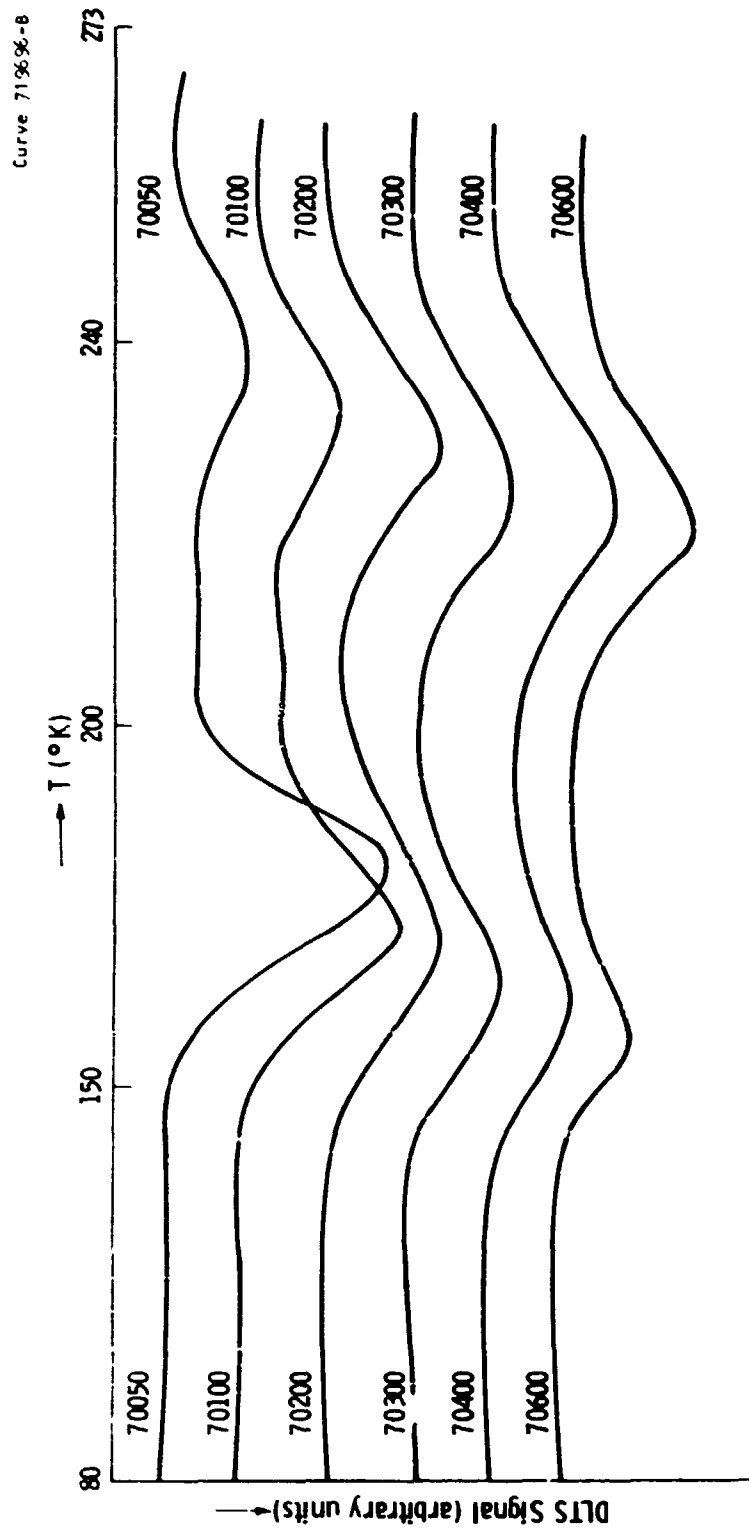


Figure 25 DLTS Spectra of Al-Induced  $E_V + .185$  eV and  $E_V + 0.51$  eV Traps (Ingot-38)

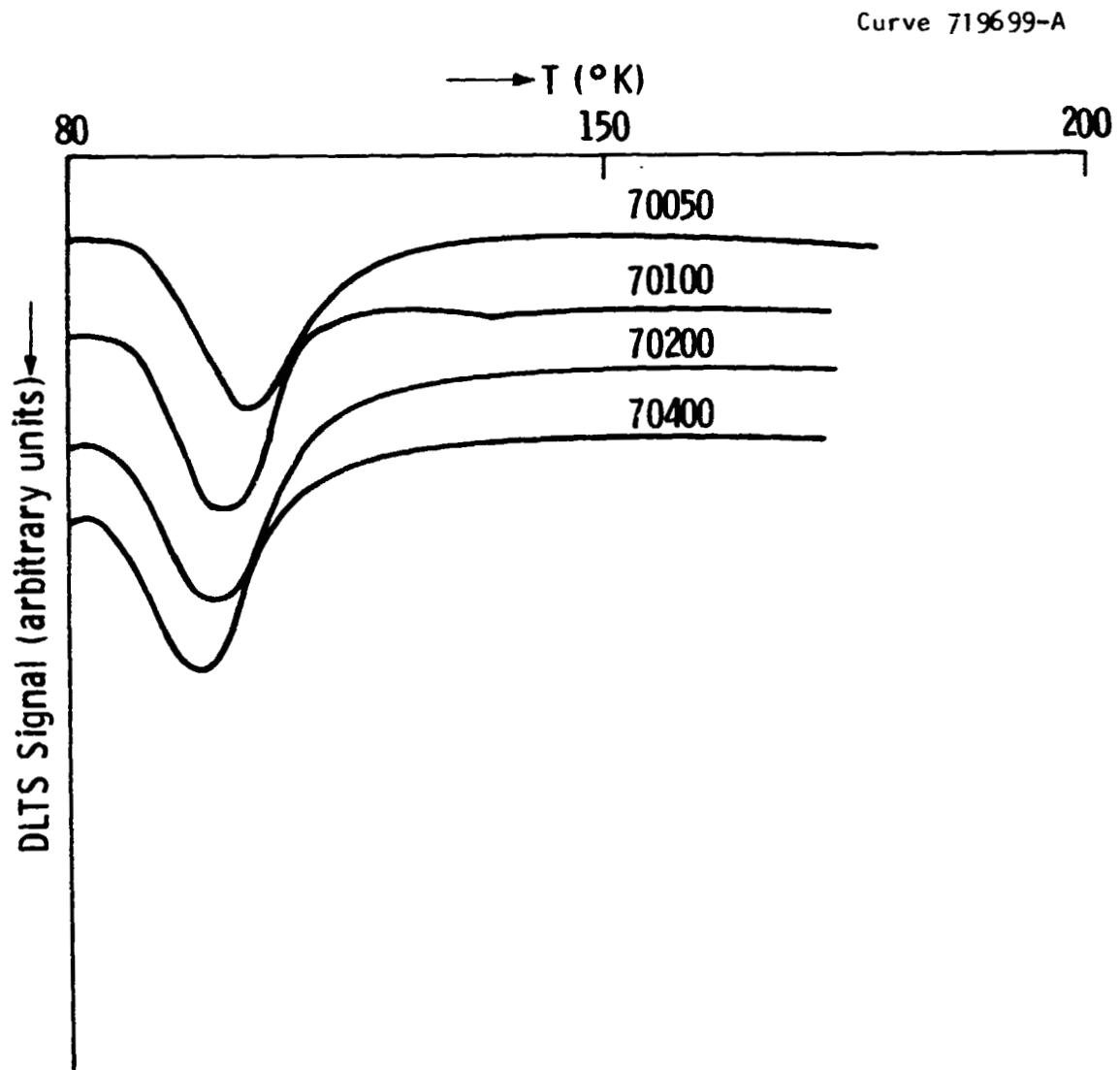


Figure 26 DLTS Spectra of Nb-Induced  $E_v + 0.12$  eV Trap



#### 4.10 Deep Levels and Trap Densities Measured by DLTS on As-Grown Ingots

The deep levels identified in Czochralski ingots and their densities are listed in Table 12. The data were obtained by deep level transient spectroscopy of Ti-Si (p-type) or Al-Si (n-type) Schottky barriers formed on wafers cut from the ingots. The techniques and data analysis are described in Section 3.3.1. Where a dash appears in the table, spectroscopy was performed but the deep level concentration was below the detection limit of the method.

TABLE 12 Deep Levels and Trap Center Concentrations in As-Grown Silicon Ingots

Ingot Identification	Trap Center eV	Trap Concentration $N_T$ ( $\text{cm}^{-3}$ )	Impurity Concentration ( $10^{15}$ atoms/ $\text{cm}^3$ )
004-Cr	$E_V+0.22$	$1.24 \times 10^{13}$	1.0
	$E_V+0.31$	$1.15 \times 10^{14}$	
005-Mn	-	-	1.3
008-Ti	$E_V+0.30$	$6.7 \times 10^{13}$	0.2
009-V	$E_V+0.42$	$9.0 \times 10^{13}$	0.4
010-Ni	-	-	4.0
012-Cr	$E_V+0.31$	$6.05 \times 10^{13}$	0.2
013-Mn	$E_V+0.38$	$3.6 \times 10^{12}$	$0.25 \times 10^{14}$
015-Zn-00	-	-	.032
	-	-	
029-Cr	$E_V+0.31$	$2.7 \times 10^{12}$	.012
030-Cr/Cu	$E_V+0.22$	$5.27 \times 10^{12}$	1/1.7
	$E_V+0.31$	$2.57 \times 10^{14}$	
031-Cr/Mn	$E_V+0.31$	$0.95 \times 10^{14}$	1/1.3
033-Ti	$E_V+0.30$	$7.2 \times 10^{11}$	.0020
035-V	$E_V+0.42$	$5.5 \times 10^{11}$	.004
036-Zr	-	-	<.0014
038-Al	$E_V+0.13$	$5.7 \times 10^{11}$	60
	$E_V+0.51$	$2.5 \times 10^{11}$	
039-Ni	-	-	8
042-Ti	$E_V+0.30$	$9.2 \times 10^{12}$	0.04
048-Ti	-	-	.0002

TABLE 12 Deep Levels and Trap Center Concentrations in As-Grown Silicon Ingots (Continued)

Ingot Identification	Trap Center eV	Trap Concentration $N_T$ ( $\text{cm}^{-3}$ )	Impurity Concentration ( $10^{15}$ atoms/ $\text{cm}^3$ )
056-Cu	-	-	65
061-Cr/Ti	$E_V+0.22$	$9.1 \times 10^{12}$	1/0.11
	$E_V+0.31$	$3.4 \times 10^{13}$	
	$E_V+0.30$	$4.1 \times 10^{12}$	
063-N/Cr	-	-	0.8
064-N/Mn	-	-	1.0
065-N/Ti	$E_C-.26$	$1.0 \times 10^{14}$	0.20
069-Fe	$E_V+.42$	$1.32 \times 10^{12}$	1.0
072-Cr	$E_V+0.22$	$1.65 \times 10^{12}$	0.4
	$E_V+0.31$	$2.8 \times 10^{13}$	
073-Cr/Mn/Ni Ti/V	$E_V+.22$	$1.65 \times 10^{12}$	0.4/.4/2/ 0024 .004
	$E_V+.31$	$3.51 \times 10^{13}$	
075-Ti/V	$E_V+.42$	$1.24 \times 10^{12}$	.056/0.1
	$E_V+.30$	$1.0 \times 10^{13}$	
076-Poly	-	-	
077-Mo	$E_V+.30$	$4.16 \times 10^{12}$	.0042
081-N/Ni	-	-	1.7
082-N/V	$E_C-.22$	$9.8 \times 10^{13}$	0.4
	$E_C-.46$	$1.3 \times 10^{14}$	
083-N/Fe	-	-	1
084-Al	$E_V+.43$	$7.3 \times 10^{11}$	50
093-Mn	-	-	0.66
095-Mn	-	-	1.0

TABLE 12 Deep Levels and Trap Center Concentrations in As-Grown Silicon Ingots (Continued)

Ingots Identification	Trap Center eV	Trap Concentration $N_T$ ( $\text{cm}^{-3}$ )	Impurity Concentration ( $10^{15}$ atoms/ $\text{cm}^3$ )
096-Mn	-	-	0.63
100-Cu/Ti	$E_V+0.30$	$1.04 \times 10^{13}$	1/.033
102-Ti-Poly	$E_V+0.30$	$4.6 \pm 2 \times 10^{13}$	.11
103* -Ti	-	-	.167
104-Cu/Ti	$E_V+0.30$	$3.6 \times 10^{13}$	2.0/0.14
105-V*	-	-	0.4
106-N/Al	-	-	10
108-N/V	$E_C-.22$ $E_C-.46$	$3.4 \times 10^{13}$ $3.4 \times 10^{13}$	.08
111-Cu/V	$E_V+0.42$	$2.6 \times 10^{13}$	2.5/0.3
112-Ta	-	-	<.004
113-Cr FZ	$E_V+0.31$	$5.0 \times 10^{13}$	0.8
119-N/Fe	-	-	0.3
120 N/Cr	-	-	0.3
121-N/Ti	$E_C-.26$	$1.77 \times 10^{13}$	0.039
122-Ti	$E_V+0.30$	$3.6 \times 10^{13}$	.084
123-Ti	$E_V+0.30$	$4.0 \times 10^{13}$	.105
124-Mo	-	-	.00046
127-FZ Ti	$E_V+0.30$	$2.96 \times 10^{13}$	.039
128-Ta	-	-	<.0008
131-Mn	-	-	.55
132-Ta	-	-	.000042

TABLE 12 Deep Levels and Trap Center Concentrations in As-Grown Silicon Ingots (Continued)

Ingot Identification	Trap Center eV	Trap Concentration $N_T$ ( $\text{cm}^{-3}$ )	Impurity Concentration ( $10^{16}$ atoms/ $\text{cm}^3$ )
135-Fe	-	-	.78
137-Ti	$E_V+0.30$	$8 \times 10^{13}$	.21
138-Mo	$E_V+0.30$	$1.0 \times 10^{12}$	.001
139-Mo	$E_V+0.30$	$4.5 \times 10^{12}$	.0042
141-Mo/Cu	$E_V+0.30$	$4.45 \times 10^{12}$	.004/4.0
145-W	$E_V+0.12$	$7.5 \times 10^{12}$	.00085
146-Co	-	-	1.5
147-N/Ni	-	-	0.33
148-N/Mn	-	-	0.60
149-N/Fe	-	-	.60
150-N/V	$E_C-0.22$ $E_C-0.31$	$1.1 \times 10^{13}$ $1 \times 10^{13}$	.03
152**-Ti	$E_V+0.30$	$3.19 \times 10^{13}$	0.21
153-N/Ti	$E_C-.26$	$6.2 \times 10^{12}$	0.013
154-N/Cr	-	-	0.50
155-N/Mo	-	-	.001
156-N/Mo	-	-	.004
157-N/Ti/V	$E_C-.22$ $E_C-.46$ $E_C-.26$	$3.7 \times 10^{13}$ $3.7 \times 10^{13}$ $4.8 \times 10^{13}$	.08/0.12
158 N/Ti/V/Cr	$E_C-.22$ $E_C-.46$ $E_C-.26$	$1.38 \times 10^{13}$ $1.38 \times 10^{13}$ $1.85 \times 10^{13}$	.05/.05/.55

TABLE 12 Deep Levels and Trap Center Concentrations in As-Grown Silicon Ingots (Continued)

Ingot Identification	Trap Center eV	Trap Concentration $N_T$ ( $\text{cm}^{-3}$ )	Impurity Concentration ( $10^{15}$ atoms/ $\text{cm}^3$ )
160-Ti*	$E_V+0.30$	$5 \times 10^{13}$	.17
177-N/Cr/Mn	-	-	1.2/1.26
178-N/Mn/Ti	$E_C-.26$	$4.6 \times 10^{13}$	.86/.08
181-Cr	$E_V+0.22$	$2.48 \times 10^{12}$	1.04
	$E_V+0.31$	$9.9 \times 10^{13}$	
183-Nb	$E_V+.18$	$1.12 \times 10^{12}$	.002
186-Co	-	-	.027
187-Co	-	-	.14
188-	-	-	.0002
189-Nb	-	-	.0003
190-Cu/Zn	-	-	2/<.0012
191-Cu/Ta	-	-	2/.00068
192-Ag	-	-	2.2
193-Sn	-	-	4.846
194-Ti	$E_V+0.30$	$1.8 \times 10^{12}$	3.0

#### 4.11 Deep Levels and Trap Densities Measured by DLTS in Impurity-Doped Solar Cells

In Table 14 are compiled the deep levels and trap densities measured on silicon solar cells fabricated from impurity-doped wafers. The front metal grid was removed from the cells and thirty mil diameter mesas were formed on the device. A Au-Ti contact was used for the front electrode, the Ti-Pd-Ag rear cell contact formed the second electrode. The DLTS procedure and data analysis are described in Section 3.3.1 Where dashes appear in the table the level was below the detection limits of the method.

TABLE 13 Deep Levels and Trap Center Densities Near the Junction Region of Silicon Solar Cells

Ingot ID	Trap Level eV	Trap Concentration
004-Cr	$E_V+0.41$	$4.4 \times 10^{12}$
005-Mn	$E_V+0.39$	$3.5 \times 10^{12}$
013-Mn	$E_V+0.38$	$2.7 \times 10^{13}$
018-Fe	$E_V+0.40$	$1.6 \times 10^{12}$
036-Zr		
038-Al	$E_V+0.43$	$1.2 \times 10^{12}$
	$E_V+0.47$	$2.4 \times 10^{12}$
077-Mo	$E_V+0.30$	$3.8 \times 10^{12}$
082-N/V	$E_C-.22$	$1.1 \times 10^{13}$
	$E_C-.46$	$9.7 \times 10^{12}$
93-Mn	-	-
96-Mn	-	-
108-V	$E_C-.22$	$2.5 \times 10^{12}$
	$E_C-.46$	$2.5 \times 10^{12}$
112-Ta	-	-
113-Cr	-	-
123-Ti	$E_V+0.30$	
127-Ti	$E_V+0.30$	
132-Ta	-	
141-Mo/Cu	$E_V+0.3$	$3.73 \times 10^{12}$
146-Co	-	-
152-Ti	$E_V+0.30$	$1.5 \times 10^{13}$
171-W	-	-



4.12 Summary of Deep Levels and Capture Cross Sections for Impurities in Silicon

The impurity-induced deep levels, and their respective capture cross sections measured by DLTS in silicon are collected in Table 14. Derivation of the capture cross section from DLTS data is described in Section 3.3.1.

TABLE 14 Measured Energy Levels and Capture Cross Sections for Impurities in Silicon and Solar Cells

Impurity	Measured Energy Levels (eV)	Measured Capture Cross Sec. $\text{cm}^2$ **
Mo	$E_V + 0.30$	$\sigma_p = 4.3 \times 10^{-16}$ at 177 K
Ti	$E_V + 0.30$	$\sigma_p = 5.29 \times 10^{-18}$ at
	$E_C - 0.26$	*
V	$E_C + .42$	$\sigma_p = 8.27 \times 10^{-19}$ at 25 K
	$E_C - .225$	$\sigma_e = 7.2 \times 10^{-17}$ at 119 K
	$E_C - .46$	*
#Mn	$E_V + 0.38$	$\sigma_p = 8.1 \times 10^{-17}$ at
#Fe	$E_V + 0.40$	$\sigma_p = 1 \times 10^{-16}$ at
Cr	$E_V + .22$	*
	$E_V + .31$	*
Ta	$E_V + .28$	
Al	$E_V + .43$	
	$E_V + .47$	
Cu		
Nb	$E_V + .18$	$\sigma_p = 1.32 \times 10^{-16}$ at

\* Cross section was greater than  $10^{-15} \text{ cm}^2$  and could not be determined.

# Data from solar cells.

\*\* Note these measured cross-sections are obtained under different conditions than those which apply to the operating solar cell and therefore cannot be used to calculate the minority carrier lifetime which controls solar cell performance.

#### 4.13 Photoconductive Decay Lifetime of Czochralski Ingots and Solar Cells

Below in Table 15 are listed the measured photoconductive decay lifetimes for both the as-grown impurity doped silicon wafers and for the wafers following  $\text{POCl}_3$  or  $\text{BBr}_3$  diffusions according to the solar cell process specification. Phase I data (through ingot W052) were taken with a GaAs LED light source. Subsequent measurements, Phases II and III employed a Q-switched Nd:YAG laser. Starting with ingot W078 calculated values of the wafer diffusion length are tabulated along with measured bulk lifetime data.

TABLE 15  
 Bulk Lifetimes (Photoconductive Decay) for Silicon Ingots  
 Before and After Phosphorus Diffusion  
 (LED EXCITATION)

<u>Ingot Identification</u>	<u>Lifetime <math>\tau</math>(<math>\mu</math>sec)</u>	<u>(As-Grown) <math>\sigma</math>(Note 1)</u>	<u>Lifetime <math>\tau</math>(<math>\mu</math>sec)</u>	<u>(Diffused) <math>\sigma</math>(Note 1)</u>
W001-00000	7.1	1.1(5)	6.9	0.5(3)
W002-00000	6.3	0.6(2)	8.6	1.6(2)
W003-00000	11.6	2.3(2)	8.4	0.7(2)
W004-Cr001	0.35	0.2(3)	1.1	0.2(4)
W005-Mn001	1.8(2)	--	0.3	0.0(5)
W006-Ni001	11.3	2.7(2)	7.7	0.2(2)
W007-Cu001	6.9	0.9(4)	6.6	3.2(3)
W008-Ti001	2.0	0.5(3)	0.6	0.1(4)
W009-V001	0.4	0.1(3)	<2.2(2)	1.8(5)
W010-Ni002	6.8	2.6(3)	3.4	3.3(4)
W011-Zr001	2.6	0.2(2)	2.4	0.7(4)
W012-Cr002	<0.4	0.1(2)	4.9	1.0(5)
W013-Mn002	1.2(2)	1.0(3)	10.5(2)	4.7(5)
W014-00000	7.5	0.4(2)	8.3	0.1(2)
W015-Zn001	7.2	0.6(2)	5.3	0.4(4)
W016-Fe001	0.5	0.0(2)	3.8	1.5(4)
W017-Cu002	8.8	0.1(2)	7.1	0.7(2)
W018-Fe002	8.1	5.5(2)	0.6	0.3(4)
W019-Cu003	4.3	3.3(2)	5.7	0.5(2)
W020-00000	7.0	1.7(2)	7.3	1.4(2)
W021-Mg001	8.2	0.8(2)	7.7	0.1(2)
W022-00000	7.8	1.0(2)	9.1	0.2(2)
W023-00000	1.93	--	2.6	0.0(2)
W024-Mg002	7.5	0.9(2)	10.2	0.9(2)
W025-00000	7.6	0.0(2)	12.7	1.0(2)
W026-Mn003	5.1	0.2(2)	9.3	0.0(2)
W027-Mn/Cu001	22.3(2)	2.3(2)	0.5	0.2(3)

TABLE 15 (Continued)

Bulk Lifetimes (Photoconductive Decay) for Silicon Ingots  
Before and After Phosphorus Diffusion  
(LED EXCITATION)

Ingot Identification	Lifetime $\tau$ ( $\mu$ sec)	(As-Grown) $\sigma$ (Note 1)	Lifetime $\tau$ ( $\mu$ sec)	(Diffused) $\sigma$ (Note 1)
W028-A1001	2.9	0.2(2)	1.9	0.0(2)
W029-Cr003	1.1	0.6(2)	6.2	0.4(4)
W030-Cr/Cu001	<0.3	0.0(2)	0.4	0.1(2)
W031-Cr/Mn001	Note 5	--	<0.3	0.0(2)
W032-Mg003	7.2	1.1(2)	7.1	1.1(2)
W033-Ti002	3.1	0.0(2)	2.9	0.1(2)
W034-0000	21.8	4.2(2)	1.7	0.1(2)
W035-V002	1.2	0.0(2)	1.5	0.2(2)
W036-Zr002	1.2	0.0(2)	1.0	0.0(2)
W037-Zr/Ti001	0.5	0.1(2)	0.4	0.1(2)
W038-A1002	0.7	0.2(2)	<0.1	0.0(2)
W039-Ni002	2.0	0.1(2)	6.5	1.5(2)
W040-Cr/Ni001	<0.2	0.0(2)	1.4	0.4(2)
W041-Ni/Cr/Cu001	<0.2	0.0(2)	0.4	0.3(2)
W042-Ti003	0.8	0.1(2)	0.7	0.1(2)
W043-Fe/Ti001	0.9	0.0(2)	0.5	0.0(2)
W044-Fe003	1.3	0.2(2)	6.6	0.1(2)
W045-Cr/Fe/Ti001	0.1	0.0(2)	1.0	0.8(4)
W046-Fe/V001	<0.1	0.0(2)	<0.1	0.0(2)
W047-Cu/Ni/Zr001	3.4	0.1(2)	2.6	0.1(2)
W048-Ti004	4.30	0.2(2)	5.1	0.4(2)
W049-V003	3.7	0.2(2)	4.3	0.1(2)
W050-Ti/V001	1.1	0.1(2)	1.1	0.1(2)
W051-Cu/Ti001	0.5	0.0(2)	1.6	0.3(2)
W052-Ni004	0.1	0.0(2)	Note 3	--

Note 1. Sample size shown in parentheses.

Note 2. Lifetime measurements subject to large errors due to extreme shallow trap density.

Note 3. Polycrystalline ingot -- no evaluation performed.

Note 4. Lifetime measurements not practical due to low resistivity.

Note 5. Lifetime measurements not possible due to very low lifetime ( $\Delta v$  too small).

TABLE 15 (Cont.)

RECOMBINATION LIFETIME MEASURED BY PHOTOCONDUCTIVE-DECAY METHOD  
(Q-SWITCHED Nd:YAG Laser Excitation)

Ingot Identification	Lifetime $\tau$ ( $\mu$ sec)	(As-Grown) $\sigma$ (Note 1)	Lifetime $\tau$ ( $\mu$ sec)	(Diffused) $\sigma$ (Note 1)
W053-00-00	*6.6	0.1 (2)	--	--
W054-0000	*6.3	0.4 (2)	--	--
W055-Cu004	*6.2	0.1 (2)	*7.8	0.6 (2)
W056-Cu005	*6.7	0.3 (2)	*5.6	1.7 (4)
W057-0000	1.84	- (1)	*4.6	0.7 (2)
W058-0000	1.76	0.94(2)	1.78	0.01(2)
W059-0000	Note 2	-	Note 2	--
W060-N/000	11.5	0.24(3)	15.7	1.79(4)
W061-Cr/Ti001	Note 2	-	0.60	0.09(2)
W062-N/Cu001	13.6	0.58(2)	12.1	2.01(2)
W063-N/Cr001	1.67	0.11(2)	0.77	0.09(4)
W064-N/Mn001	0.26	0.04(2)	7.64	1.63(5)
W065-N/Ti001	0.16	0.01(2)	0.34	0.21(4)
W066-Ti005	0.49	0.0 (2)	0.73	0.0 (2)
W067-Cr-Mn/Ti	Notes 2 & 3	-	0.75	0.2 (2)
W068-Cr004	0.03	0.00(2)	0.85	0.1 (2)
W069-Fe004	0.04	0.01(2)	1.80	0.3 (2)
W070-Al003	1.75	0.07(2)	0.88	0.0 (2)
W071-00-000	3.75	0.31(2)	6.43	1.2 (2)
W072-Cr-005	0.06	0.01(2)	1.75	0.04(2)
W073-Cr/Mn/Ni/Ti/V-001	Note 3	-	0.09	0.02(2)
W074-Cr/Mn/Ni/Ti/V-002	0.10	0.01(2)	1.68	0.28(2)
W075-Ti/V-002	0.06	0.01(2)	0.10	0.04(2)
W076-Poly-002	0.48	0.00(2)	2.51	0.37(2)
W077-Mo-001	0.36	0.13(2)	0.31	0.00(2)

Note 1. Sample size shown in parenthesis

Note 2. Insufficient electrical signal for measurement

Note 3. Lifetime measurements subject to large errors due to extreme shallow trap density

\* Measured by LED excitation source

TABLE 15

RECOMBINATION LIFETIME MEASURED BY PHOTOCONDUCTIVE-DECAY METHOD  
(Q-Switched Nd: YAG Laser Excitation)

Ingot Identification	Diffusivity $D_n/D_p$ (cm <sup>2</sup> /s)	As Grown		Post Diffusion	
		Lifetime $\tau_T$ ( $\mu$ s)	Diff. Length L ( $\mu$ m)	Lifetime $\tau_T$ ( $\mu$ s)	Diff. Length L ( $\mu$ m)
W078-00-000	32.4	8.32	164	---	---
W079-N/00-000	11.7	86.5	308	---	---
W080-Ph-001	32.4	4.39	119	2.48	89.6
W081-N/Ni-001	10.5	5.62	76.8	10.36	104
W082-N/V-001	10.5	0.20	16.2	0.25	16.2
W083-N/Fe-001	11.7	1.56	42.7	---	---
W084-Al-001	32.4	0.97	56.1	1.00	56.9
W085-N/Zr-001	11.7	140	405	---	---
W086-C-001	32.0	3.06	99.0	2.30	85.8
W087-Ca-001	31.9	2.81	94.7	2.08	81.5
W088 <sup>*</sup> -Cr-001	15.3	0.01	3.9	2.23	58.4
W089 <sup>*</sup> -Cu-001	15.3	2.37	60.2	3.06	68.4
W090 <sup>*</sup> -Mn-001	14.8	0.06	9.4	1.73	50.6
W091-Cr/Mn-002	32.4	0.09	17.1	0.20	25.5
W092-Ph-002	32.2	7.83	159	5.49	133
W093-Mn-004	32.9	0.19 <sup>3</sup>	25.0	0.70	48.0
W094-Mn-005	32.4	0.38 <sup>3</sup>	35.1	2.58	91.4
W095-Mn-006	32.9	0.15	22.2	0.38	35.4
W096-Mn-007	32.9	0.34 <sup>3</sup>	33.4	2.32	87.4
W097-00-000	32.7	4.78	125	2.66	93.3
W098-Mo-002	32.4	1.40	67.3	0.89	53.7
W099-Fz-001	32.2	4.34	118	3.12	100
W100-Cu/Ti-002	32.4	0.30	31.2	0.37	34.6
W101-Fz-002	32.7	4.30	119	9.58	177
W102-Ti-006	32.9	0.21	26.3	0.29 <sup>3</sup>	30.9
W103 <sup>*</sup> -Ti-001	15.1	0.12	13.5	0.07	10.3
W104-Cu/Ti-003	33.4	0.16	23.1	0.45	38.8

Note 1.

Note 2. Insufficient electrical signal for measurement.

Note 3 Lifetime measurements subject to large errors due to extreme shallow trap density.

TABLE 15 (Cont.)

RECOMBINATION LIFETIME MEASURED BY PHOTOCONDUCTIVE-DECAY METHOD  
(Q-Switched Nd: YAG Laser Excitation)

Ingot Identification	Diffusivity $D_n/D_p$ (cm <sup>2</sup> /s)	As Grown		Post Diffusion	
		Lifetime $\tau_r$ (us)	Diff. Length L (um)	Lifetime $\tau_r$ (us)	Diff. Length L (um)
W05-V-001	14.8	0.07	10.2	0.07	10.2
W106-N/Al-002	11.7	16.56	139	---	---
W107-Fz/Al-001	25.0	2.61	80.8	1.65	64.2
W108-N/V-002	11.5	0.72	28.8	---	---
W109-C-002	32.4	3.05	99.4	1.72	74.7
W110-Fe-001	13.8	Note 2	---	Note 2	---
W111-Cu/V-001	32.9	0.15	22.2	0.16	22.9
W112-Ta-001	32.4	1.06	58.6	0.68	46.9
W113-Fz/Cr-001	32.7	0.13	20.6	0.65	46.1
W114-00-000	7.5	6.75	71.2	Note 2	---
W115-N/Cu-002	11.7	8.39	99.1	5.99	83.7
W116-Ph-001	21.7	1.61	59.1	2.40	72.2
W117-00-000	32.4	3.65	109	2.76	94.6
W118-Ph-003	26.8	4.16	106	29.3	280
W119-N/Fe-002	11.7	5.21	78.1	3.20	61.2
W120-N/Cr-002	11.6	---	---	3.19	60.9
W121-N/Ti-002	11.5	---	---	2.13	49.5
W122-Ti-007	32.2	0.68	46.8	---	---
W123-Ti-008	32.4	0.59	43.7	0.41	36.4
W124-Mo-003	32.6	1.94	79.5	2.18	84.3
W125-Mo-004	32.4	1.32	65.4	1.46	68.8
W-126-MULTI-1	32.7	0.09	17.2	0.97	56.3
W-127-FZ/TI-001	33.2	0.92	55.3	1.08	59.9
W128-TA-00	32.4	2.62	92.1	1.94	79.3
W-129-Cu-000	---	---	---	---	---
W130-00-000	---	---	---	---	---
W-131-Mn-008	---	---	---	---	---

Note 1.

Note 2. Insufficient electrical signal for measurement.

Note 3. Lifetime measurements subject to large errors due to extreme shallow trap density.

TABLE 15 (Cont.)

RECOMBINATION LIFETIME MEASURED BY PHOTOCONDUCTIVE-DECAY METHOD  
(Q-Switched Nd: YAG Laser Excitation)

Ingot Identification	Diffusivity $D_n/D_p$ (cm <sup>2</sup> /s)	As Grown		Post Diffusion	
		Lifetime $\tau_r$ ( $\mu$ s)	Diff. Length L ( $\mu$ m)	Lifetime $\tau_r$ ( $\mu$ s)	Diff. Length L ( $\mu$ m)
W-132-Ta-003	32.2	2.69	93.1	1.65	72.9
W-133-00-000	31.9	1.61	71.7	2.80	94.5
W-134-Ti-009	32.7	0.79	50.8	0.58	43.5
W-135-Fe-005	32.4	0.34	33.2	1.69	74.0
W-136-Fe-006	31.4	0.07	14.8	0.59	43.0
W-137-Ti-010	32.4	0.79	50.6	---	---
W-138-Mo-005	32.7	1.38	67.2	0.97	5.3
W-139-Mo-006	32.2	0.27	29.5	---	---
W-140-Ti-011					
W-141	---	---	---	---	---
W-142	---	---	---	---	---
W-143	---	---	---	---	---
W-144	---	---	---	---	---
W-145	---	---	---	---	---
W-146	---	---	---	---	---
W-147-N/Ni-002	11.62			5.79	82.0

Note 1.

Note 2. Insufficient electrical signal for measurement.

Note 3. Lifetime measurements subject to large errors due to extreme shallow trap density.



#### 4.14 Solar Cell I-V Data for Impurity-Doped Ingots

For the solar cell I-V data listed in Table 16 the following test conditions apply: (1) quartz iodine solar spectrum simulator (2) illumination level  $91.6 \text{ mW/cm}^2$ , (3) cell area  $1.03 \text{ cm}^2$  and (4) no antireflection coating.

Ingots are listed in chronologic order as they were grown. Column headings are self explanatory. For some ingots PCD lifetime data (Table 15) were also tabulated; PCDB and DCDA refer to wafer lifetimes before and after junction diffusion.

The abbreviations in the table are as follows:

- R - calibrated reference devices
- C - wafers from ingot center
- T - wafers from ingot ingot end (tang)
- S - wafers from ingot seed end
- B - uncontaminated baseline wafer
- E or N - end
- \* - item deleted from averages

## 5. SELECTED PROPERTIES OF SILICON

We have tabulated below values for a number of the more commonly used properties of liquid and solid silicon. The data, which were compiled by R. G. Seidensticker, complement the chemical, electrical, and solar cell information which makes up Section 4. Listed with the property data are references to the sources from which the information was obtained. In the second part of the table are listed semiconductor data for silicon.

### MATERIALS DATA

#### Silicon: Solid

<u>Parameter</u>	<u>Temp (°K)</u>	<u>Value</u>	<u>Ref.</u>
Density	298.2	2.32902 gm/cm <sup>3</sup>	(21)
	1685	2.2861	(22)
Heat Capacity	1373	.9811 J/gm-K	(23)
Conductivity, Thermal	300	1.56 W/cm-K	(24)
	1683	0.216	(24)
	1683<T<800	$K = \frac{318}{T}$	
Diffusivity, Thermal	800	.143 cm <sup>2</sup> /sec	(25)
	1200	.116	
	1685	.0939	
Emissivity (Total)	700	.69	(26)
	1250	.62	(26)
	1500	.45-.75	(27)
Expansivity, $\frac{1}{x} \frac{dx}{dT}$	700	$4.56 \times 10^{-6}$	(28)
Melting Temperature	1685		(29)
Heat of Fusion		1804 J/gm	(30)

Silicon: Liquid

Density	1685	2.49 gm/cm <sup>3</sup>	(22)
Heat Capacity	1685	1.05 J/gm-K	(31)
Volume Expansivity, $\frac{1}{V} \frac{dV}{dT}$	1685	1.45 x 10 <sup>-4</sup> K <sup>-1</sup>	(32)
Conductivity, Thermal	1685	0.67 W/cm-K	(33)
	<u>Corrected</u>	.60	
Diffusivity, Thermal	1685	~0.23 cm <sup>2</sup> /sec	(34)
Emissivity	1685	0.22	(34)
Resistivity, Electrical	1685	81 x 10 <sup>-6</sup> ohm-cm	(35)
Surface Tension	1685	719 dyne/cm	(36)
Viscosity	1685	2.9x10 <sup>-3</sup> Stokes	(35)

Calculated Prandtl Number = .012

## SEMICONDUCTOR DATA (Ref.17)

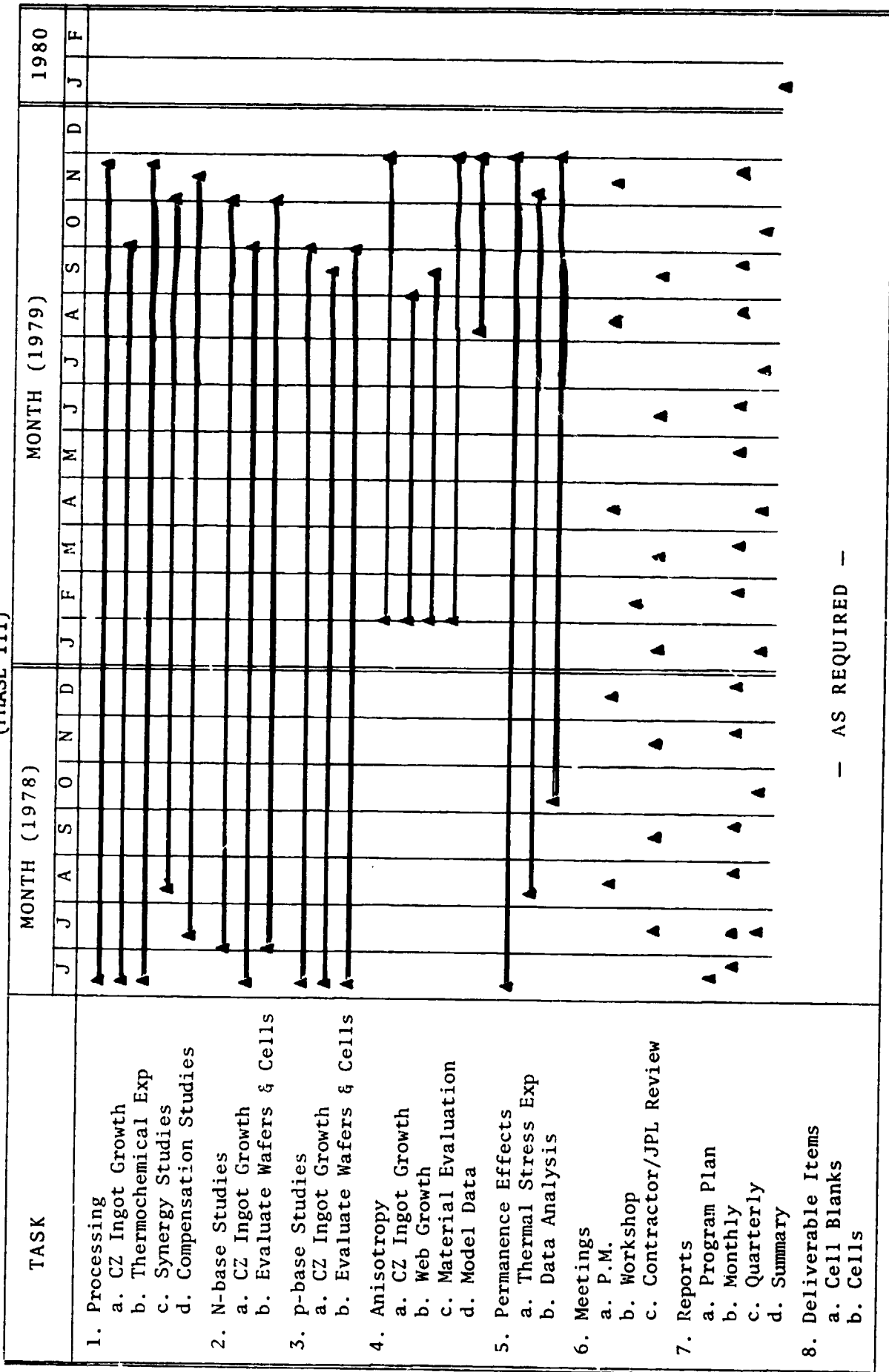
Atomic or Molecular Weight	28.09
Atoms or Molecules/cm <sup>3</sup>	5.00 x 10 <sup>22</sup>
Crystal Structure	Diamond, 8 atoms/unit cell
Lattice constant (A)	5.43
Density, $\rho$ (g/cm <sup>3</sup> )	2.33
Energy gap (ev)	1.11
Effective density of states conduction band N <sub>c</sub> (cm <sup>-3</sup> )	2.8x10 <sup>19</sup>
valence band N <sub>v</sub> (cm <sup>-3</sup> )	1.04 x 10 <sup>19</sup>
Intrinsic Carrier Concentration	1.45x10 <sup>10</sup>
Lattice (intrinsic) mobilities (cm <sup>2</sup> /v sec)	
electrons	1350
holes	480
Dielectric constant	11.7
Breakdown field (v/ $\mu$ )	~30

6. Program Status

All tasks in the Phase III effort have been completed successfully; the milestone chart is illustrated in Figure 27.

Figure 27

PROGRAM PLAN (SCHEDULE)  
(PHASE III)



— AS REQUIRED —

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TABLE 16 SOLAR CELL I-V DATA

60105 W004CR001(1E15) W002 00 000

\*SOL4 1 / 7 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	22.37	.556	20.56	-7.814	1.51	.32	.745	9.80	4.53	8.60	6.30
2B*	19.85	.554	18.29	-8.024	1.46	.28	.752	8.74	2.86	8.60	6.30
3B	22.70	.557	20.92	-7.982	1.47	.25	.752	10.06	3.90	8.60	6.30
4B	22.37	.557	20.84	-9.083	1.25	.62	.764	10.07	3.90	8.60	6.30
1C	17.25	.525	15.92	-8.404	1.32	.84	.745	7.13	.91	1.05	.35
2C	17.50	.530	16.06	-7.803	1.46	.28	.745	7.31	1.04	1.05	.35
3C	14.90	.520	12.95	-5.387	2.44	-1.19	.679	5.57	.78	1.05	.35
4C	18.37	.530	16.98	-8.492	1.31	.79	.748	7.70	1.17	1.05	.35
5C	16.12	.520	14.78	-6.024	2.05	-.33	.697	6.17	.91	1.05	.35
6C	18.90	.535	17.55	-9.046	1.22	1.11	.749	8.01	1.00	1.05	.35
1E	18.00	.534	16.75	-9.254	1.19	1.14	.754	7.66	1.04	1.05	.35
2E	18.75	.534	17.13	-7.636	1.51	.66	.730	7.73	1.04	1.05	.35
3E	18.75	.534	17.39	-8.963	1.23	1.20	.745	7.89	.91	1.05	.35
AVERAGES: 60105 BASELINE W002 00 000											
	22.48	.557	20.77	-8.293	1.41	.40	.754	9.98	4.11	8.60	6.30
STD	.16	.000	.16	.563	.11	.16	.008	.12	.30	*	*
60105 W004CR001(1E15)											
	17.62	.529	16.11	-7.890	1.53	.50	.732	7.24	.98	1.05	.35
STD	1.28	.006	1.46	1.282	.41	.75	.025	.79	.11	*	*
PERCENT OF BASELINE											
	78.4	95.0	77.6	104.9	108	125.5	97.2	72.6	23.8	12.2	5.6
STD%	6.3	1.1	7.7	23.0	40	315.6	4.3	8.9	4.5	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60225A W004CR001(1E15) W002 00 000

\*SOL4 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	22.20	.559	20.69	-8.873	1.29	.14	.776	10.19	3.90	8.42	11.65
2B	22.20	.559	20.09	-6.664	1.86	-.44	.735	9.64	3.90	8.42	11.65
3B	22.20	.559	20.60	-8.524	1.36	.28	.764	10.03	4.55	8.42	11.65
4B	22.20	.559	20.39	-7.559	1.58	-.15	.754	9.90	3.90	8.42	11.65
5B	22.55	.559	20.98	-8.688	1.33	.15	.772	10.29	4.16	8.42	11.65
2C	20.70	.525	18.11	-5.201	2.49	-1.74	.703	8.08	.91	1.05	.35
3C	18.00	.525	17.02	-11.430	.91	1.45	.778	7.77	.91	1.05	.35
4C	18.50	.525	17.25	-9.368	1.15	.95	.760	7.81	1.30	1.05	.35
5C.*	18.65	.519	15.07	-3.667	4.46	-5.35	.635	6.50	.52	1.05	.35
1S	18.50	.515	17.04	-7.405	1.52	-1.38	.784	7.90	1.17	1.05	.35
2S	18.15	.530	16.96	-9.501	1.14	.80	.768	7.81	1.17	1.05	.35
3S.*	18.15	.530	14.58	-3.792	4.31	-3.75	.610	6.21	.26	1.05	.35
4S	18.75	.530	17.19	-7.479	1.54	-.29	.753	7.92	1.17	1.05	.35
1T	18.25	.523	16.69	-7.529	1.51	.19	.740	7.47	.91	1.05	.35
2T	18.00	.528	16.65	-8.410	1.32	.41	.757	7.61	.91	1.05	.35
3T*	18.00	.263	11.48	-2.774	4.11	-1.47	.415	2.08	.01	1.05	.35

AVERAGES: 60225A BASELINE W002 00 000

22.27 .559 20.55 -8.062 1.48 -.00 .760 10.01 4.08 8.42 11.65

STD .14 .000 .30 .833 .21 .26 .015 .23 .25 \* \*

60225A W004CR001(1E15)

18.61 .525 17.11 -8.290 1.45 .05 .755 7.80 1.06 1.05 .35

STD .83 .004 .42 1.734 .45 1.05 .024 .17 .15 \* \*

PERCENT OF BASELINE

83.5 93.9 83.3 97.2 97 \*\*\*\*\* 99.4 77.9 25.9 12.5 3.0

STDZ 4.3 .8 3.3 34.4 49 \*\*\*\*\* 5.1 3.6 5.6 .0 .0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60108 W005MN001(1.3E15) W002 00 000

\*SOL4 1 / 7 / 80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCD <sub>a</sub>	PCD <sub>b</sub>
1R*	22.50	.554	20.54	-7.538	1.57	.61	.728	9.60	5.00	8.60	6.30
1B	22.60	.550	21.18	-9.427	1.18	.17	.786	10.34	.46	8.60	6.30
2B	22.40	.550	20.82	-8.466	1.35	-.12	.777	10.12	.46	8.60	6.30
3B	22.60	.550	21.31	-10.408	1.05	.49	.791	10.40	5.20	8.60	6.30
4B	22.50	.550	20.93	-8.549	1.33	-.07	.777	10.17	3.90	8.60	6.30
5B	22.40	.550	20.92	-9.131	1.23	.31	.776	10.11	5.20	8.60	6.30
1C	17.75	.523	16.64	-9.721	1.10	.54	.780	7.66	1.04	.22	1.80
2C	17.00	.515	15.75	-8.652	1.25	.62	.756	7.00	.65	.22	1.80
3C	17.50	.520	16.31	-9.075	1.19	.49	.769	7.40	1.04	.22	1.80
4C	17.50	.520	16.31	-9.075	1.19	.49	.769	7.40	.91	.22	1.80
5C	17.50	.520	16.31	-9.075	1.19	.49	.769	7.40	.91	.22	1.80
1E	16.75	.515	15.61	-9.143	1.17	.51	.770	7.02	.78	.22	1.80
2E	17.35	.516	16.06	-8.209	1.34	-.18	.759	7.28	.91	.22	1.80
3E	16.75	.516	15.63	-9.161	1.17	.35	.775	7.08	.91	.22	1.80
4E	17.20	.516	16.11	-9.756	1.08	.77	.774	7.26	.91	.22	1.90

AVERAGES: 60108 BASELINE W002 00 000

	22.50	.550	21.03	-9.196	1.23	.16	.781	10.23	3.04	8.60	6.30
STD	.09	.000	.18	.704	.11	.23	.006	.12	2.16	*	*
	60108 W005MN001(1.3E15)										
	17.26	.518	16.08	-9.096	1.18	.45	.770	7.28	.90	.22	1.80
STD	.34	.003	.33	.450	.07	.25	.006	.20	.11	*	*
PERCENT OF BASELINE											
	76.7	94.2	76.5	101.1	96	290.5	98.6	71.2	29.4	2.6	28.6
STD%	1.8	.5	2.3	12.8	15	822.5	1.6	2.8	27.4	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60114 W006NI001(1.6E15) W002 00 000  
 \*SOL4 1 / 7 / 80 AMI: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.90	.550	20.67	-6.669	1.83	-.03	.722	9.62	5.00	8.60	6.90
1B	22.75	.549	21.09	-8.432	1.35	.22	.764	10.09	5.20	8.60	6.90
2B	22.15	.549	20.38	-7.672	1.52	-.19	.759	9.76	4.55	8.60	6.90
3B	22.75	.549	21.08	-8.362	1.36	.17	.764	10.09	5.85	8.60	6.90
4B	22.30	.549	20.65	-8.274	1.38	.09	.765	9.90	5.20	8.60	6.90
1C	21.65	.535	19.84	-7.593	1.51	.24	.742	9.08	3.90	7.70	11.27
2C	21.65	.539	20.14	-8.755	1.27	.30	.768	9.48	5.20	7.70	11.27
3C	21.65	.539	19.93	-7.738	1.48	-.11	.758	9.35	3.90	7.70	11.27
4C	21.65	.539	20.14	-8.755	1.27	.30	.768	9.48	5.20	7.70	11.27
5C	21.65	.539	19.93	-7.738	1.48	-.11	.758	9.35	4.55	7.70	11.27
6C	21.65	.535	19.84	-7.593	1.51	.24	.742	9.08	3.25	7.70	11.27
1E	22.70	.545	21.12	-8.849	1.26	.47	.764	10.00	5.20	7.70	11.30
2E	22.50	.545	20.85	-8.395	1.35	.26	.762	9.88	5.20	7.70	11.30
3E	22.50	.540	20.70	-7.570	1.52	-.40	.764	9.81	5.20	7.70	11.30
4E	22.50	.545	20.85	-8.395	1.35	.26	.762	9.88	5.85	7.70	11.30
5E	22.40	.540	20.73	-8.556	1.31	.71	.749	9.58	4.55	7.70	11.30
5E	22.50	.545	20.85	-8.395	1.35	.26	.762	9.88	5.20	7.70	11.30
7E	22.00	.535	19.99	-6.467	1.86	-1.54	.765	9.52	5.20	7.70	11.30
8E	22.50	.540	20.81	-8.022	1.41	-.19	.769	9.88	5.20	7.70	11.30
AVERAGES: 60114 BASELINE W002 00 000											
	22.49	.549	20.80	-8.185	1.41	.07	.767	9.96	5.20	8.60	6.90
STD	.27	.000	.30	.301	.07	.16	.002	.14	.46	*	*
60114 W006NI001(1.6E15)											
	22.11	.540	20.41	-8.059	1.42	.05	.759	9.59	4.83	7.70	11.29
STD	.42	.004	.45	.637	.15	.52	.009	.29	.68	*	*
PERCENT OF BASELINE											
	98.3	98.4	98.1	101.5	101	66.7	99.5	96.3	92.9	89.5	163.6
STDZ	3.1	.7	3.6	11.6	16	*****	1.5	4.3	22.5	.1	.3

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60120 W007CU001(2E15) W002 00 000

\*SOL4 : / / 80 AMI: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.60	.557	19.99	-5.516	2.40	-1.41	.715	9.52	7.00	5.20	6.30
2B	22.30	.550	20.65	-8.228	1.40	.01	.766	9.94	.00	8.60	6.90
3B	22.30	.545	20.78	-8.894	1.26	.25	.773	9.93	.00	8.60	6.90
4B	22.60	.550	21.20	-9.726	1.14	.50	.780	10.25	.00	8.60	6.90
1C	22.50	.550	21.06	-9.242	1.21	.10	.785	10.28	.00	6.64	6.90
2C	22.60	.550	21.16	-9.725	1.14	.79	.769	10.11	.00	6.64	6.90
3C	22.60	.550	21.11	-9.074	1.24	.13	.781	10.27	.00	6.64	6.90
4C	22.50	.545	20.94	-8.748	1.28	.23	.771	9.99	.00	6.64	6.90
5C	22.40	.545	20.74	-7.797	1.48	-.91	.788	10.17	.00	6.64	6.90
6C	22.50	.545	20.64	-7.398	1.58	-.35	.757	9.81	.00	6.64	6.90
1E	22.50	.545	21.09	-9.591	1.15	.42	.780	10.12	.00	6.64	6.90
2E	22.40	.545	20.69	-8.064	1.42	.08	.760	9.81	.00	6.64	6.90
3E	22.50	.550	20.98	-8.852	1.28	.04	.780	10.20	.00	6.64	6.90
4E	22.50	.546	20.65	-7.463	1.57	-.25	.755	9.81	.00	6.64	6.90
5E	22.50	.547	21.10	-9.791	1.12	.60	.777	10.12	.00	6.64	6.90
6E	21.75	.542	20.17	-8.441	1.34	.22	.764	9.52	.00	6.64	6.90
AVERAGES: 60120 BASELINE W002 00 000											
	22.40	.548	20.88	-8.949	1.26	.25	.773	10.04	.00	8.60	6.90
STD	.14	.002	.23	.613	.11	.20	.006	.15	.00	*	*
60120 W007CU001(2E15)											
	22.44	.547	20.86	-8.682	1.32	.09	.772	10.02	.00	6.64	6.90
STD	.22	.003	.28	.817	.16	.43	.011	.22	.00	*	*
PERCENT OF BASELINE											
	100.2	99.7	99.9	103.0	104	35.6	99.9	99.8	*****	77.2	100.0
STD%	1.6	.9	2.5	16.4	22	330.8	2.1	3.7	*****	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60204 W007CU001(2E15) W002 00 000

\*SOL4 1 / 7 / 80 AMI: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	QCD	PCDa	PCDb
1R*	22.62	.547	20.69	-7.543	1.55	.41	.735	9.61	4.55	8.60	6.90
1B.*	22.87	.552	20.27	-5.434	2.43	-1.89	.727	9.71	3.90	8.60	6.90
2B	22.30	.545	20.25	-6.717	1.80	-.68	.745	9.58	3.90	8.60	6.90
3B	22.87	.552	21.28	-8.515	1.34	-.15	.779	10.40	4.55	8.60	6.90
4B	23.25	.552	21.68	-8.709	1.30	-.21	.786	10.67	5.20	8.60	6.90
5B	22.87	.552	21.05	-7.597	1.55	-.40	.764	10.21	2.21	8.60	6.90
1C	22.75	.552	21.37	-9.789	1.13	.29	.789	10.47	2.60	6.64	6.90
2C	22.75	.547	20.43	-6.068	2.06	-1.19	.737	9.69	4.55	6.64	6.90
3C	22.75	.552	21.43	-10.298	1.07	.54	.787	10.46	3.90	6.64	6.90
4C	22.75	.552	21.43	-10.298	1.07	.54	.787	10.46	3.25	6.64	6.90
5C	22.75	.547	20.71	-6.875	1.75	-.59	.749	9.85	4.55	6.64	6.90
1S*	22.62	.547	12.81	-1.573	****	*****	.501	6.55	1.95	6.64	6.90
2S	22.75	.547	21.27	-9.425	1.17	.61	.770	10.14	3.25	6.64	6.90
3S*	22.75	.540	21.37	-11.310	.93	2.26	.737	9.58	1.56	6.64	6.90
1R*	22.62	.550	20.66	-7.513	1.57	.51	.730	9.61	4.55	6.64	6.90
1T	22.62	.550	20.58	-6.769	1.79	-.78	.751	9.88	3.90	6.64	6.90
2T	22.62	.550	21.06	-8.576	1.33	-.17	.781	10.28	4.16	6.64	6.90
3T	22.62	.550	20.88	-7.904	1.47	-.17	.765	10.06	2.99	6.64	6.90

AVERAGES: 60204 BASELINE W002 00 000

	22.82	.550	21.07	-7.884	1.50	-.36	.769	10.21	3.97	8.60	6.90
STD	.34	.003	.52	.794	.20	.21	.016	.40	1.11	*	*

60204 W007CU001(2E15)

	22.71	.550	21.02	-8.445	1.43	-.10	.768	10.14	3.68	6.64	6.90
STD	.06	.002	.36	1.523	.34	.61	.018	.28	.65	*	*

PERCENT OF BASELINE

	99.5	99.9	99.8	92.9	95	171.6	100.0	99.3	92.9	77.2	100.0
STD%	1.8	.9	4.2	32.0	39	287.7	4.5	6.7	47.2	.0	.1

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60205 W008T1001(2E14) W003 00 000

\*SOL4 1 / 7 / 80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.70	.555	20.85	-7.855	1.49	.47	.741	9.88	4.55	8.60	6.90
1B	22.80	.558	20.77	-6.747	1.83	-.99	.757	10.19	3.90	2.45	11.30
2B	22.80	.558	20.77	-6.747	1.83	-.99	.757	10.19	3.90	2.45	11.30
3B	22.80	.558	20.77	-6.747	1.83	-.99	.757	10.19	3.90	2.45	11.30
4B	22.60	.555	20.46	-6.391	1.95	-1.22	.751	9.96	3.90	2.45	11.30
5B	22.60	.558	20.68	-7.062	1.72	-.85	.763	10.18	4.55	2.45	11.30
1C.*	7.80	.428	6.23	-4.129	3.53	-6.61	.601	2.12	.20	.58	2.00
2C.*	7.80	.430	6.43	-4.576	2.91	-4.30	.625	2.22	.26	.58	2.00
3C	7.80	.446	7.17	-8.297	1.20	.59	.748	2.75	.26	.58	2.00
4C.*	7.60	.420	5.81	-3.815	4.12	-6.95	.556	1.88	.16	.58	2.00
5C	7.80	.438	6.85	-6.140	1.81	-.27	.683	2.47	.26	.58	2.00
1S	7.80	.445	7.11	-7.574	1.36	-.24	.739	2.71	.07	.58	2.00
2S	7.70	.445	6.90	-6.608	1.65	-1.61	.722	2.62	.14	.58	2.00
3S.*	7.60	.429	6.04	-4.084	3.64	-7.10	.597	2.06	.20	.58	2.00
4S.*	7.70	.445	6.59	-5.012	2.56	-6.17	.686	2.48	.20	.58	2.00
1T.*	7.60	.438	6.22	-4.256	3.42	-9.27	.643	2.26	.26	.58	2.00
3T	7.60	.443	6.89	-7.261	1.44	-.63	.734	2.61	.21	.58	2.00
4T	7.60	.443	6.89	-7.261	1.44	-.63	.734	2.61	.08	.58	2.00

AVERAGES: 60205 BASELINE W003 00 000

	22.72	.557	20.65	-6.739	1.83	-1.01	.757	10.14	4.03	2.45	11.30
STD	.10	.001	.12	.213	.07	.12	.004	.09	.26	*	*

60205 W008T1001(2E14)

	7.72	.443	6.97	-7.190	1.49	-.47	.727	2.63	.17	.58	2.00
STD	.09	.003	.12	.686	.20	.65	.021	.09	.08	*	*

PERCENT OF BASELINE

	34.0	79.5	33.7	93.3	81	154.0	96.0	25.9	4.2	23.7	17.7
STD%	.5	.6	.8	13.9	15	77.7	3.3	1.1	2.4	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60206 W009V001(4E14) W003 00 000  
 \*SOL4 1 / 7 / 80 AMI: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.75	.553	20.86	-7.725	1.52	.43	.739	9.83	4.55	1.90	6.90
1B	22.50	.555	20.89	-8.240	1.41	-.41	.782	10.32	5.20	8.42	11.60
2B	22.50	.555	20.86	-8.167	1.42	-.31	.776	10.25	3.90	8.42	11.60
3B	22.20	.552	20.25	-7.256	1.65	.05	.738	9.57	2.86	8.42	11.60
4B	22.60	.555	20.74	-7.501	1.58	-.19	.754	10.00	3.90	8.42	11.60
5B	22.50	.555	20.65	-7.403	1.61	-.40	.758	10.02	3.90	8.42	11.60
1C	10.20	.467	9.47	-8.743	1.16	-.11	.773	3.89	.20	2.17	.40
2C	10.20	.467	9.47	-8.743	1.16	-.11	.773	3.89	.26	2.17	.40
3C	10.20	.467	9.47	-8.743	1.16	-.11	.773	3.89	.39	2.17	.40
4C	10.20	.467	9.47	-8.743	1.16	-.11	.773	3.89	.26	2.17	.40
5C	10.20	.467	9.47	-8.743	1.16	-.11	.773	3.89	.26	2.17	.40
1S	10.25	.465	9.47	-8.486	1.20	.44	.757	3.81	.33	2.17	.40
2S	10.25	.469	9.55	-9.236	1.08	.38	.775	3.94	.26	2.17	.40
3S	10.25	.469	9.55	-9.236	1.08	.38	.775	3.94	.26	2.17	.40
1T	10.20	.465	9.35	-7.757	1.35	-.32	.751	3.77	.26	2.17	.40
2T	10.20	.468	9.52	-9.455	1.05	.73	.772	3.90	.39	2.17	.40
3T	10.20	.468	9.52	-9.455	1.05	.73	.772	3.90	.26	2.17	.40
4T	10.20	.462	9.46	-8.907	1.12	.89	.758	3.78	.26	2.17	.40
AVERAGES: 60206 BASELINE W003 00 000											
	22.46	.554	20.68	-7.713	1.53	-.25	.762	10.03	3.95	8.42	11.60
STD	.14	.001	.23	.408	.10	.17	.016	.26	.74	*	*
60206 W009V001(4E14)											
	10.21	.467	9.48	-8.854	1.14	.22	.769	3.88	.28	2.17	.40
STD	.02	.002	.05	.449	.08	.40	.008	.06	.06	*	*
PERCENT OF BASELINE											
	45.5	84.2	45.8	85.2	74	288.9	100.9	38.6	7.1	25.8	3.4
STDZ	.4	.5	.3	12.2	10	327.9	3.1	1.6	3.0	.0	.0



TABLE 16 SOLAR CELL I-V DATA (Cont.)

60220 W010N1002(1.6E16) W003 00 000

\*SOL4 1 / 7 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCl	CDa	PCDb
1R*	22.75	.553	21.07	-8.840	1.28	1.14	.740	9.85	4.55	8.42	6.30
1B.*	22.25	.545	17.97	-3.457	5.03	-6.10	.651	8.35	2.21	8.42	6.30
2B.*	23.00	.534	19.69	-4.955	2.69	-.46	.653	8.48	1.04	8.42	6.30
3B.*	22.37	.552	15.63	-2.145	****	*****	.625	8.16	3.90	8.42	6.30
4B	22.12	.552	20.17	-6.973	1.73	-.61	.751	9.70	3.25	8.42	6.30
5B.*	22.12	.552	19.85	-5.876	2.18	-1.89	.748	9.66	3.25	8.42	6.30
1C	19.37	.530	18.22	-10.445	1.01	1.05	.775	8.41	1.43	3.43	6.80
2C	19.37	.530	18.09	-9.323	1.16	.53	.772	8.38	1.30	3.43	6.80
3C	19.37	.527	17.75	-7.505	1.52	-.12	.750	8.09	1.17	3.43	6.80
4C	19.10	.527	17.70	-8.692	1.26	.70	.754	8.03	1.17	3.43	6.80
5C	19.37	.523	17.70	-7.686	1.46	.76	.727	7.79	.91	3.43	6.80
1S	19.00	.530	17.76	-9.553	1.13	.81	.768	8.18	1.43	3.43	6.80
2S	19.00	.525	17.16	-6.609	1.79	-.51	.731	7.71	1.04	3.43	6.80
3S	18.70	.530	17.35	-8.550	1.30	.22	.766	8.03	1.43	3.43	6.80
4S	19.00	.530	17.76	-9.553	1.13	.81	.768	8.18	1.43	3.43	6.80
1T	19.00	.530	17.82	-9.870	1.09	.73	.776	8.26	1.43	3.43	6.80
2T	19.00	.522	16.95	-6.078	2.00	-.70	.715	7.49	.78	3.43	6.80
3T	19.00	.530	17.82	-9.870	1.09	.73	.776	8.26	1.30	3.43	6.80

AVERAGES: 60220 BASELINE W003 00 000

	22.12	.552	20.17	-6.973	1.73	-.61	.751	9.70	3.25	8.42	6.30
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
	60220 W010N1002(1.6E16)										
	19.11	.528	17.67	-8.644	1.33	.42	.756	8.07	1.24	3.43	6.80
STD	.71	.003	.35	1.333	.30	.55	.020	.27	.22	*	*
PERCENT OF BASELINE											
	86.4	95.6	87.6	76.0	77	268.9	100.7	83.2	38.0	40.7	107.9
STD%	.9	.5	1.7	19.1	17	90.0	2.7	2.7	6.6	.0	.1

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60221 W011ZR001(<7E11) W003 00 000

\*SOL4 1 / 7 / 80 AM1: PO=91.60MW/CM`2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	22.50	.550	20.46	-6.751	1.80	-.76	.749	9.81	3.90	8.42	11.60
2B	22.37	.552	20.68	-7.922	1.47	-.36	.772	10.08	4.55	8.42	11.60
3B	22.37	.550	20.22	-6.516	1.89	-.63	.736	9.58	2.99	8.42	11.60
4B	22.50	.550	20.46	-6.751	1.80	-.76	.749	9.81	1.95	8.42	11.60
5B	22.50	.545	20.24	-6.332	1.94	-.57	.727	9.43	2.60	8.42	11.60
1C	22.00	.545	20.70	-9.858	1.11	.13	.795	10.08	3.90	1.08	2.60
2C	22.00	.545	20.18	-7.375	1.59	-.43	.758	9.61	3.25	1.08	2.60
3C	21.75	.542	19.96	-7.507	1.55	-.21	.754	9.41	2.21	1.08	2.60
4C	21.75	.542	19.84	-7.259	1.62	.05	.738	9.20	1.95	1.08	2.60
5C	22.00	.545	20.46	-8.640	1.30	.08	.773	9.81	3.90	1.08	2.60
1S	22.37	.540	20.68	-8.051	1.41	-.05	.764	9.76	3.29	1.08	2.60
2S	22.37	.547	20.93	-9.224	1.21	.15	.783	10.14	3.90	1.08	2.60
3S	22.25	.540	20.22	-6.565	1.84	-1.24	.758	9.64	3.64	1.08	2.60
4S	22.37	.540	20.56	-7.371	1.58	-.70	.768	9.81	3.90	1.08	2.60
1T	22.50	.550	21.21	-10.403	1.05	.54	.790	10.33	4.55	1.30	2.60
2T	21.50	.550	20.14	-9.454	1.18	.29	.783	9.79	3.90	1.30	2.60
3T	22.00	.550	20.48	-8.742	1.30	.16	.773	9.89	3.90	1.30	2.60
4T	22.00	.550	20.52	-8.970	1.26	.24	.775	9.92	3.90	1.30	2.60

AVERAGES: 60221 BASELINE W003 00 000

	22.45	.549	20.41	-6.855	1.78	-.62	.747	9.74	3.20	8.42	11.60
STD	.06	.002	.17	.557	.16	.15	.015	.22	.93	*	*

60221 W011ZR001(<7E11)

	22.07	.545	20.45	-8.417	1.38	-.08	.770	9.80	3.55	1.15	2.60
STD	.28	.004	.37	1.114	.22	.45	.015	.29	.70	*	*

PERCENT OF BASELINE

	98.3	99.2	100.2	77.2	78	187.7	103.2	100.6	111.1	13.6	22.4
STDZ	1.5	1.1	2.7	27.5	21	93.9	4.2	5.3	60.4	1.2	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60225 W012CR002 (2E14) W002 00 000  
 \*SOL4 1 / 77 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.554	20.68	-7.872	1.49	.44	.743	9.79	3.90	8.60	6.30
1B	22.60	.558	20.87	-7.965	1.48	-.07	.763	10.17	1.95	8.60	6.30
2B.*	19.70	.549	17.04	-4.813	2.95	-2.83	.699	7.99	3.90	8.60	6.30
3B	22.12	.555	20.47	-8.227	1.41	.08	.764	9.92	1.95	8.60	6.30
4B.*	21.82	.551	19.44	-5.967	2.14	-.67	.713	9.06	2.60	8.60	6.30
5B	20.10	.551	18.50	-7.523	1.58	-.78	.771	9.03	3.90	8.60	6.30
1C	21.75	.543	19.62	-6.536	1.86	-.37	.727	9.09	2.60	4.90	.40
2C	21.50	.550	19.87	-8.012	1.45	-.17	.767	9.59	3.25	4.90	.40
3C	21.75	.546	19.65	-6.447	1.91	-.84	.739	9.28	2.60	4.90	.40
4C	21.75	.546	19.44	-5.907	2.15	-1.29	.730	9.17	2.21	4.90	.40
5C	21.50	.546	19.13	-5.668	2.28	-1.66	.729	9.04	2.21	4.90	.40
1E	21.50	.535	18.65	-5.098	2.60	-1.23	.683	8.31	.13	4.90	.40
2E	22.00	.546	19.15	-5.148	2.61	-1.28	.688	8.74	1.95	4.90	.40
3E	21.63	.550	19.39	-6.128	2.06	-.89	.727	9.14	2.99	4.90	.40
4E	22.00	.550	19.94	-6.815	1.78	-.20	.732	9.37	3.12	4.90	.40
5E	21.87	.550	19.19	-5.315	2.51	-1.45	.703	8.94	2.21	4.90	.40
6E	21.00	.537	18.33	-5.159	2.58	-1.65	.697	8.32	1.04	4.90	.40
7E	20.75	.535	18.37	-5.769	2.19	-.72	.704	8.26	1.17	4.90	.40
AVERAGES: 60225 BASELINE W002 00 000											
	21.61	.555	19.95	-7.905	1.49	-.26	.766	9.71	2.60	8.60	6.30
STD	1.08	.003	1.04	.291	.07	.37	.004	.49	.92	*	*
60225 W012CR002 (2E14)											
	21.58	.544	19.23	-6.000	2.16	-.98	.719	8.94	2.12	4.90	.40
STD	.36	.006	.52	.822	.36	.51	.023	.42	.89	*	*
PERCENT OF BASELINE											
	99.9	98.2	96.4	124.1	145	*****	93.8	92.1	81.7	57.0	6.3
STD%	6.8	1.5	7.7	13.6	32	*****	3.5	9.2	75.4	.0	.0

TABLE 16 SOLAR CF I-V DATA (Cont.)

60407 W013MN002 (2.5E14) BEFORE SINTER W002 00 000  
 \*SOL4 1 /7 /80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	22.25	.555	20.80	-9.202	1.23	.28	.778	10.16	5.20	8.57	6.34
2B	22.50	.546	20.18	-6.152	2.02	-.79	.727	9.44	3.90	8.57	6.34
3B	22.50	.550	20.45	-6.800	1.78	-.60	.745	9.76	4.55	8.57	6.34
4B	22.60	.550	20.71	-7.207	1.65	-.65	.761	10.01	4.55	8.57	6.34
1C	22.00	.540	19.97	-6.765	1.77	-.51	.741	9.31	3.25	10.53	1.20
2C	22.00	.545	20.18	-7.347	1.60	-.51	.760	9.64	3.90	10.53	1.20
3C	22.00	.545	20.18	-7.347	1.60	-.51	.760	9.64	3.90	10.53	1.20
4C	22.25	.545	20.72	-8.601	1.31	-.15	.781	10.01	4.55	10.53	1.20
5C	22.25	.545	20.66	-8.489	1.33	.08	.770	9.88	3.90	10.53	1.20
1S	22.50	.540	20.42	-6.920	1.71	-.06	.732	9.40	3.90	10.53	1.20
2S	22.50	.545	20.94	-8.748	1.28	.23	.771	9.99	4.81	10.53	1.20
3S	22.00	.545	20.50	-8.978	1.24	.40	.769	9.76	4.55	10.53	1.20
4S	22.50	.540	20.42	-6.920	1.71	-.06	.732	9.40	3.90	10.53	1.20
1T	22.25	.545	20.89	-9.895	1.10	.59	.780	10.00	4.55	10.53	1.20
2T	22.25	.545	20.70	-8.736	1.29	.24	.770	9.88	4.55	10.53	1.20

AVERAGES: 60407 BASELINE W002 00 000

	22.46	.550	20.53	-7.340	1.67	-.44	.753	9.34	4.55	8.57	6.34
STD	.13	.003	.24	1.139	.29	.42	.019	.27	.46	*	*

60407 W013MN002 (2.5E14) BEFORE SINTER

	22.23	.544	20.51	-8.068	1.45	-.02	.760	9.72	4.16	10.53	1.20
STD	.20	.002	.29	.996	.22	.36	.017	.25	.45	*	*

PERCENT OF BASELINE

	99.0	98.8	99.9	90.1	87	194.6	101.0	98.7	91.4	122.9	18.9
STD%	1.5	1.0	2.6	32.7	30	164.7	4.9	5.3	20.0	.1	.0

60407A W013MN002 (2.5E14) AFTER SINTER W002 00 000  
 \*SOL4 1 /7 /80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	22.60	.555	21.34	-10.230	1.08	-.04	.808	10.72	5.20	8.57	6.30
3B	22.90	.560	21.69	-11.324	.97	.82	.792	10.74	4.55	8.57	6.30
4B	22.90	.560	21.69	-11.324	.97	.82	.792	10.74	4.55	8.57	6.30
1C	22.50	.540	20.94	-8.577	1.30	-.08	.778	9.99	3.25	10.53	1.20
2C	22.00	.540	20.47	-8.491	1.32	-.22	.781	9.81	3.90	10.53	1.20
3C	22.00	.540	20.77	-10.469	1.02	.37	.797	10.01	3.90	10.53	1.20
4C	22.00	.540	20.47	-8.491	1.32	-.22	.781	9.81	4.55	10.53	1.20
5C	22.00	.540	20.47	-8.491	1.32	-.22	.781	9.81	3.90	10.53	1.20
1S	22.40	.540	20.51	-7.131	1.65	-.76	.763	9.76	3.90	10.53	1.20
2S	22.40	.540	21.06	-9.527	1.15	-.26	.804	10.28	4.81	10.53	1.20
3S	22.00	.540	20.49	-8.446	1.33	-.50	.790	9.92	4.55	10.53	1.20
4S	22.40	.540	20.75	-8.105	1.40	-.28	.774	9.90	3.90	10.53	1.20
1T	22.40	.558	21.06	-9.839	1.14	.19	.793	10.48	4.55	2.56	1.20

AVERAGES: 60407A BASELINE W002 00 000

	22.80	.558	21.57	-10.959	1.00	.53	.797	10.73	4.77	8.57	6.30
STD	.14	.002	.17	.516	.05	.40	.007	.01	.31	*	*

60407A W013MN002 (2.5E14) AFTER SINTER

	22.21	.542	20.70	-8.757	1.29	-.20	.784	9.98	4.12	9.73	1.20
STD	.21	.005	.24	.900	.16	.30	.011	.22	.45	*	*

PERCENT OF BASELINE

	97.4	97.0	95.9	120.1	129	-37.5	98.3	92.9	86.5	113.6	19.0
STD%	1.5	1.4	1.8	12.4	24	128.1	2.3	2.2	15.6	27.9	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60424 W015ZN001 (<1E12) W002 00 000  
 \*SOL4 1 / 7 / 80 AMI: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	21.75	.540	20.28	-8.656	1.29	-.28	.786	9.77	3.90	8.57	6.30
2B	21.75	.540	20.28	-8.656	1.29	-.28	.786	9.77	3.90	8.57	6.30
3B	21.10	.540	19.35	-7.315	1.60	-.64	.762	9.19	3.25	8.57	6.30
4B	21.50	.540	19.90	-8.171	1.39	-.08	.768	9.42	3.25	8.57	6.30
1C	21.80	.540	20.04	-7.468	1.55	-.54	.765	9.52	3.90	5.28	7.20
2C	22.10	.540	20.58	-8.563	1.31	-.24	.783	9.88	4.55	5.28	7.20
3C*	21.70	.527	17.94	-3.836	4.05	-4.44	.662	8.01	1.95	5.28	7.20
4C	22.10	.540	20.32	-7.684	1.50	-.08	.755	9.53	3.90	5.28	7.20
1S	22.30	.540	20.44	-7.161	1.64	-.84	.766	9.76	3.90	5.28	7.20
2S*	19.50	.537	17.40	-5.794	2.20	-.78	.732	8.11	3.25	5.28	7.20
1T	22.10	.530	19.93	-6.271	1.92	-1.11	.742	9.20	2.60	5.28	7.20
2T	22.20	.534	20.10	-6.511	1.84	-.85	.744	9.32	3.25	5.28	7.20
3T	22.20	.540	20.45	-7.577	1.52	-.57	.770	9.76	3.90	5.28	7.20
A201*	22.20	.540	20.80	-9.326	1.18	.04	.789	10.00	4.81	2.17	*****
A202*	22.20	.540	20.49	-7.714	1.49	-.57	.773	9.81	4.55	2.17	*****
A203*	22.20	.540	20.49	-7.714	1.49	-.57	.773	9.81	4.55	2.17	*****
A221*	22.20	.530	19.76	-5.515	2.29	-2.14	.740	9.21	3.25	40.00	*****
A223*	22.20	.530	20.32	-7.034	1.65	-.94	.766	9.53	3.25	40.00	*****
AVERAGES: 60424 BASELINE W002 00 000											
	21.53	.540	19.95	-8.199	1.39	-.32	.776	9.54	3.58	8.57	6.30
STD	.27	.000	.38	.547	.13	.20	.011	.25	.33	*	*
60424 W015ZN001 (<1E12)											
	22.11	.538	20.27	-7.319	1.61	-.60	.761	9.57	3.71	5.28	7.20
STD	.15	.004	.23	.712	.19	.34	.013	.23	.57	*	*
PERCENT OF BASELINE											
	102.7	99.6	101.6	110.7	116	11.9	98.1	100.3	103.9	61.6	114.3
STDZ	2.0	.7	3.1	15.2	26	290.2	3.1	5.1	26.9	.0	.1

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60610 W016FE001 (8.9E14) W003 00 000  
 \*SOL4 1 / 7 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCD <sub>a</sub>	PCD <sub>b</sub>
1B	23.00	.554	21.47	-8.941	1.27	.08	.780	10.51	5.85	8.42	11.65
2B	23.20	.554	21.56	-8.473	1.35	-.04	.774	10.53	5.46	8.42	11.65
3B	23.20	.554	21.56	-8.473	1.35	-.04	.774	10.53	5.20	8.42	11.65
4B	23.00	.554	21.47	-8.941	1.27	.08	.780	10.51	5.20	8.42	11.65
5B	23.00	.554	21.47	-8.941	1.27	.08	.780	10.51	5.20	8.42	11.65
1C	21.00	.535	19.65	-9.281	1.18	.11	.785	9.33	2.86	3.76	.50
2C	21.70	.540	20.33	-9.329	1.18	.07	.788	9.76	3.64	3.76	.50
3C	21.20	.535	19.73	-8.612	1.29	-.08	.778	9.33	3.25	3.76	.50
4C	21.20	.535	19.73	-8.612	1.29	-.08	.778	9.33	2.99	3.76	.50
5C	21.60	.535	19.87	-7.559	1.52	-.45	.764	9.34	2.86	3.76	.50
1S	22.20	.540	20.83	-9.684	1.12	-.34	.785	9.95	3.25	3.76	.50
2S	21.90	.540	20.43	-8.877	1.25	.03	.780	9.76	3.25	3.76	.50
3S	21.90	.540	20.27	-8.064	1.41	-.29	.772	9.65	2.99	3.76	.50
1T	20.50	.532	19.20	-9.411	1.15	.20	.785	9.05	2.47	3.76	.50
2T	19.50	.530	18.14	-8.947	1.22	.61	.762	8.33	1.56	3.76	.50
3T	17.60	.519	16.47	-9.527	1.12	.56	.775	7.49	.91	3.76	.50
4T	18.00	.519	16.75	-8.745	1.24	-.01	.777	7.68	.91	3.76	.50
AVERAGES: 60610 BASELINE W003 00 000											
	23.08	.554	21.50	-8.754	1.30	.03	.778	10.52	5.38	8.42	11.65
STD	.10	.000	.04	.229	.04	.06	.002	.01	.25	*	*
60610 W016FE001 (8.9E14)											
	20.69	.533	19.28	-8.887	1.25	.09	.777	9.08	2.60	3.76	.50
STD	1.47	.007	1.36	.598	.11	.30	.008	.78	.91	*	*
PERCENT OF BASELINE											
	89.7	96.3	89.7	98.5	96	264.2	99.9	86.4	48.3	44.7	4.3
STDZ	6.8	1.3	6.5	9.7	12	*****	1.4	7.5	20.1	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
60316 W017CU002(1.9E16) W003 00 000											
*SOL4 1 / 7 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING											
1B	22.75	.550	20.44	-6.079	2.07	-1.20	.737	9.76	3.25	8.42	11.60
2B.*	22.25	.550	19.89	-5.951	2.14	-1.09	.726	9.40	3.25	8.42	11.60
3B	22.75	.550	20.93	-7.455	1.58	-.62	.768	10.16	3.25	8.42	11.60
4B	22.25	.542	20.07	-6.475	1.88	-.52	.731	9.32	1.95	8.42	11.60
5B	22.75	.550	20.93	-7.455	1.58	-.62	.768	10.16	4.55	8.42	11.60
1C	21.75	.532	19.33	-5.655	2.23	-1.51	.725	8.88	1.95	7.13	8.82
2C	22.20	.537	19.83	-5.855	2.13	-1.30	.730	9.20	2.60	7.13	8.82
3C	21.74	.530	19.22	-5.514	2.30	-1.40	.714	8.70	1.95	7.13	8.82
4C	22.00	.532	19.93	-6.666	1.77	-.52	.738	9.13	2.21	7.13	8.82
5C	21.75	.532	19.44	-5.907	2.09	-1.25	.729	8.93	2.21	7.13	8.82
1S	21.60	.532	19.29	-5.842	2.13	-1.37	.730	8.87	2.21	7.13	8.80
2S	21.60	.535	19.22	-5.910	2.11	-.73	.712	8.70	1.95	7.13	8.80
3S	21.60	.540	19.77	-7.419	1.57	-.02	.745	9.20	2.86	7.13	8.80
1T	21.25	.540	19.05	-6.104	2.04	-.98	.728	8.84	2.21	7.13	8.80
2T	21.25	.540	19.27	-6.614	1.83	-.87	.746	9.05	2.47	7.13	8.80
3T	21.25	.540	19.70	-8.417	1.34	.16	.765	9.29	2.47	7.13	8.80
AVERAGES: 60316 BASELINE W003 C0 000											
	22.63	.548	20.59	-6.866	1.76	-.74	.751	9.85	3.25	8.42	11.60
STD	.22	.003	.36	.605	.21	.27	.017	.35	.92	*	*
60316 W017CU002(1.9E16)											
	21.64	.535	19.46	-6.355	1.96	-.89	.733	8.98	2.28	7.13	8.81
STD	.29	.004	.28	.838	.28	.54	.014	.19	.28	*	*
PERCENT OF BASELINE											
	95.6	97.7	94.5	107.4	110	79.2	97.6	91.2	70.2	84.7	75.9
STDZ	2.2	1.3	3.1	21.4	31	144.2	4.2	5.3	30.9	.0	.1
60317 W018FE002(1.7E15) W003 00 000											
*SOL4 1 / 7 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING											
ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	22.00	.556	20.32	-7.948	1.48	-.20	.766	9.91	4.55	8.42	11.65
2B	22.00	.556	20.32	-7.948	1.48	-.20	.766	9.91	4.55	8.42	11.65
3B	22.00	.556	20.32	-7.948	1.48	-.20	.766	9.91	4.55	8.42	11.65
4B	22.00	.550	19.73	-6.043	2.09	-1.22	.735	9.40	2.99	8.42	11.65
1C.*	14.30	.490	11.85	-4.114	3.60	-5.46	.659	4.88	.26	.61	8.13
2C	14.30	.500	12.81	-6.218	1.91	-1.47	.728	5.51	.26	.61	8.13
3C.*	14.30	.490	12.05	-4.370	3.24	-4.82	.675	5.00	.26	.61	8.13
4C.*	14.30	.490	12.05	-4.370	3.24	-4.82	.675	5.00	.26	.61	8.13
5C	14.30	.500	12.81	-6.218	1.91	-1.47	.728	5.51	.39	.61	8.13
1S	14.25	.490	12.48	-5.411	2.30	-2.22	.703	5.19	.26	.61	8.10
2S	14.00	.490	12.21	-5.266	2.40	-2.61	.701	5.08	.26	.61	8.10
AVERAGES: 60317 BASELINE W003 00 000											
	22.00	.555	20.18	-7.472	1.63	-.45	.758	9.78	4.16	8.42	11.65
STD	.00	.003	.25	.825	.27	.44	.014	.22	.68	*	*
60317 W018FE002(1.7E15)											
	14.21	.495	12.58	-5.778	2.13	-1.94	.715	5.32	.29	.61	8.12
STD	.12	.005	.25	.443	.22	.49	.013	.19	.06	*	*
PERCENT OF BASELINE											
	64.6	89.3	62.3	122.7	131	*****	94.3	54.4	7.0	7.2	69.7
STDZ	.6	1.3	2.0	15.1	37	634.6	3.5	3.2	2.7	.0	.1

TABLE 16 SOLAR CELL I-V DATA (ct.)

60323 W019CU003(4E14) W003 00 000

\*SOL4 1 / 7 / 80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.550	20.63	-7.895	1.47	.80	.731	9.56	5.00	8.42	11.65
3B	22.00	.550	20.59	-9.707	1.14	.89	.766	9.80	4.55	8.42	11.65
1C	22.00	.540	20.25	-8.164	1.39	.78	.738	9.27	3.51	1.95	4.30
2C	22.00	.540	20.69	-10.009	1.08	.46	.786	9.88	4.55	1.95	4.30
3C	21.75	.540	20.26	-8.847	1.26	.19	.774	9.61	3.51	1.95	4.30
1S	22.40	.540	20.76	-7.990	1.42	-.60	.782	10.00	4.16	1.95	4.30
2S	22.00	.540	20.45	-8.241	1.37	-.59	.788	9.89	5.20	1.95	4.30
3S	22.00	.540	20.45	-8.241	1.37	-.59	.788	9.89	3.90	1.95	4.30
4S	22.00	.540	20.44	-8.598	1.30	.22	.767	9.64	3.90	1.95	4.30
1T	22.80	.556	21.07	-8.355	1.38	.60	.749	10.04	3.90	1.95	4.30
2T	22.30	.556	20.79	-8.936	1.27	.24	.774	10.15	4.16	1.95	4.30
3T	21.50	.556	19.74	-8.387	1.38	1.62	.717	9.06	3.64	1.95	4.30

AVERAGES: 60323 BASELINE W003 00 000

	22.00	.550	20.59	-9.707	1.14	.89	.766	9.80	4.55	8.42	11.65
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*

60323 W019CU003(4E14)

	22.08	.545	20.49	-8.577	1.32	.23	.766	9.74	4.04	1.95	4.30
STD	.34	.007	.35	.555	.10	.67	.023	.33	.49	*	*

PERCENT OF BASELINE

	100.3	99.1	99.5	111.6	116	26.4	100.0	99.4	88.9	23.2	36.9
STD%	1.5	1.3	1.7	5.7	8	75.1	3.0	3.4	10.8	.0	.0

60427 W021MG001 (3E12) W002 00 000

\*SOL4 1 / 7 / 80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	22.30	.545	20.89	-9.329	1.19	.10	.787	10.11	4.55	8.57	6.30
2B	22.30	.550	21.06	-10.712	1.01	.57	.793	10.29	5.20	8.57	6.30
3B	22.00	.550	20.75	-10.407	1.05	.45	.793	10.15	4.94	8.57	6.30
4B	22.30	.550	20.83	-9.035	1.24	.12	.780	10.12	5.20	8.57	6.30
1C	22.50	.553	21.03	-9.097	1.24	.08	.783	10.30	4.16	7.74	8.20
2C	22.50	.540	21.01	-8.907	1.24	-.10	.786	10.10	4.55	7.74	8.20
3C	22.50	.558	21.04	-9.083	1.25	-.06	.788	10.46	5.20	7.74	8.20
4C*	21.50	.532	19.67	-7.266	1.59	-.36	.752	9.10	2.60	7.74	8.20
5C	21.80	.537	20.37	-9.044	1.22	.01	.784	9.71	4.16	7.74	8.20
1S	22.30	.540	20.76	-8.740	1.27	.14	.774	9.85	4.55	7.74	8.20
2S	22.00	.540	20.39	-8.266	1.36	-.04	.769	9.66	4.29	7.74	8.20
3S	22.00	.540	20.2	-9.386	1.17	.08	.788	9.91	5.20	7.74	8.20
1T	22.40	.540	20.98	-9.437	1.16	.31	.781	9.99	5.20	7.74	8.20
2T	22.50	.540	21.01	-9.104	1.21	.23	.778	9.99	4.55	7.74	8.20
3T	22.40	.540	20.98	-9.437	1.16	.31	.781	9.99	4.55	7.74	8.20
4T	22.40	.540	20.98	-9.437	1.16	.31	.781	9.99	4.94	7.74	8.20

AVERAGES: 60427 BASELINE W002 00 000

	22.23	.543	20.88	-9.871	1.12	.31	.788	10.17	4.97	8.57	6.30
STD	.13	.002	.12	.705	.09	.20	.005	.07	.27	*	*

60427 W021MG001 (3E12)

	22.30	.543	20.83	-9.085	1.22	.12	.781	10.00	4.67	7.74	8.20
STD	.24	.006	.25	.342	.06	.15	.006	.22	.39	*	*

PERCENT OF BASELINE

	100.3	98.9	99.8	108.0	109	37.0	99.1	98.3	93.9	90.3	130.2
STD%	1.7	1.5	1.7	10.3	15	102.1	1.4	2.9	13.2	.1	.0



TABLE 16 SOLAR CELL I-V DATA (Cont.)

60421 W024MG002 (3E13) W002 00 000

\*SOL4 1 / 7 / 80 AMI: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	EFF	OCD	PCDa	PCDb
1B	23.00	.545	21.44	-8.417	1.34	-.66	.796	10.55	5.20	8.57	6.30
2B	22.60	.545	21.10	-8.722	1.29	-.43	.794	10.34	5.20	8.57	6.30
3B	22.60	.545	21.07	-8.676	1.30	-.18	.784	10.21	4.55	8.57	6.30
4B	22.50	.545	20.88	-8.194	1.39	-.38	.780	10.11	4.55	8.57	6.30
1C	22.60	.545	21.14	-9.122	1.22	.03	.785	10.23	4.94	10.24	7.50
2C	22.60	.545	21.14	-9.122	1.22	.03	.785	10.23	5.20	10.24	7.50
3C	22.40	.545	20.73	-7.937	1.45	-.45	.775	10.01	4.94	10.24	7.50
4C	22.50	.545	21.11	-9.513	1.16	.13	.789	10.24	4.55	10.24	7.50
5C	22.60	.545	21.14	-9.122	1.22	.03	.785	10.23	4.16	10.24	7.50
1S	22.30	.535	20.61	-7.845	1.44	-.46	.773	9.76	4.16	10.24	7.50
2S	22.50	.535	20.71	-7.353	1.57	-.92	.776	9.88	4.16	10.24	7.50
3S	22.60	.532	20.62	-6.929	1.68	-.71	.755	9.60	3.38	10.24	7.50
1T	22.30	.540	20.80	-8.725	1.28	-.20	.785	10.00	4.94	10.24	7.50
2T	22.60	.540	21.22	-9.406	1.16	-.20	.799	10.32	5.20	10.24	7.50
3T	22.30	.540	20.80	-8.725	1.28	-.20	.785	10.00	4.55	10.24	7.50

AVERAGES: 60421 BASELINE W002 00 000

	22.58	.545	21.12	-8.502	1.33	-.41	.788	10.30	4.88	8.57	6.30
STD	.19	.000	.20	.212	.04	.17	.007	.16	.33	*	*
	60421 W024MG002 (3E13)										
	22.48	.541	20.91	-8.527	1.33	-.26	.781	10.04	4.56	10.24	7.50
STD	.13	.005	.23	.833	.17	.32	.011	.22	.53	*	*
PERCENT OF BASELINE											
	99.1	99.2	99.2	99.7	100	136.0	99.1	97.5	93.6	119.5	119.0
STD%	1.4	.8	2.0	12.5	16	136.2	2.2	3.7	17.9	.1	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60422 W026MN003 (1.2E13) W002 00 000

\*SOL4 1 / 7 / 80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	22.50	.555	20.61	-7.243	1.66	-.56	.759	10.02	3.90	8.57	6.30
2B	22.60	.555	21.06	-8.816	1.29	.16	.775	10.28	4.29	8.57	6.30
3B	23.00	.555	21.16	-7.609	1.55	-.24	.759	10.25	4.29	8.57	6.30
4B	22.20	.548	20.52	-7.997	1.44	-.15	.766	9.86	3.25	8.57	6.30
1C	22.50	.545	21.09	-9.556	1.15	.34	.782	10.15	4.81	9.32	5.10
2C	22.50	.545	20.95	-9.132	1.22	.82	.757	9.82	3.90	9.32	5.10
3C	22.50	.545	20.86	-8.273	1.37	-.08	.771	10.00	4.16	9.32	5.10
4C	22.50	.545	20.46	-7.009	1.70	-.10	.736	9.54	3.90	9.32	5.10
5C	22.50	.545	21.02	-9.090	1.22	.20	.779	10.10	4.55	9.32	5.10
1S	22.50	.545	20.58	-7.148	1.66	-.55	.756	9.80	3.90	9.32	5.10
2S	22.50	.545	20.58	-7.148	1.66	-.55	.756	9.80	3.25	9.32	5.10
3S	22.50	.545	19.98	-5.658	2.27	-1.32	.721	9.34	3.25	9.32	5.10
1T	22.50	.545	20.83	-8.222	1.38	.10	.763	9.90	4.55	9.32	5.10
2T	22.50	.545	20.75	-7.868	1.46	-.05	.760	9.85	3.90	9.32	5.10
3T	22.50	.545	20.75	-7.868	1.46	-.05	.760	9.85	4.55	9.32	5.10
4T*	22.50	.538	19.70	-5.198	2.53	-1.55	.702	8.99	2.21	9.32	5.10
AVERAGES: 60422 BASELINE W002 00 000											
	22.58	.553	20.84	-7.916	1.49	-.20	.765	10.10	3.93	8.57	6.30
STD	.29	.003	.27	.584	.13	.25	.006	.17	.42	*	*
60422 W026MN003 (1.2E13)											
	22.50	.545	20.71	-7.906	1.51	-.11	.758	9.83	4.07	9.32	5.10
STD	.00	.000	.29	1.082	.30	.53	.017	.22	.50	*	*
PERCENT OF BASELINE											
	99.7	98.5	99.4	100.1	101	142.0	99.1	97.3	103.4	108.8	81.0
STD%	1.3	.6	2.7	22.0	31	687.7	3.0	3.9	25.2	.1	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60423 W027CU-MN001 (1.7E15,1.3E15) W002 00 000  
 \*SOL4 1 / 7 / 80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	22.40	.550	20.84	-8.493	1.34	-.24	.782	10.18	4.16	8.57	6.34
2B	23.00	.550	20.68	-6.145	2.04	-1.06	.736	9.85	3.90	8.57	6.34
3B	23.00	.550	21.24	-7.794	1.49	-.40	.770	10.30	4.55	8.57	6.34
4B	23.00	.550	20.74	-6.153	2.04	-1.39	.748	10.00	3.90	8.57	6.34
5B	23.00	.550	21.24	-7.794	1.49	-.40	.770	10.30	4.55	8.57	6.34
1C	17.00	.510	15.66	-7.660	1.45	-.74	.769	7.06	.91	.45	22.30
2C	17.00	.510	15.66	-7.660	1.45	-.74	.769	7.06	.78	.45	22.30
3C	17.00	.510	15.66	-7.660	1.45	-.74	.769	7.06	.78	.45	22.30
4C	16.70	.510	15.50	-8.329	1.30	-.49	.780	7.02	.78	.45	22.30
5C	17.40	.510	15.96	-7.188	1.57	-1.39	.774	7.27	.91	.45	22.30
6C	16.50	.510	15.24	-8.029	1.36	-.30	.767	6.82	.65	.45	22.30
1S	17.60	.510	16.12	-7.410	1.51	-.39	.753	7.15	.91	.45	22.30
2S	17.40	.510	16.13	-8.206	1.32	-.54	.779	7.31	.91	.45	22.30
1T	16.00	.510	14.73	-7.889	1.40	-.07	.756	6.52	.65	.45	22.30
2T	16.50	.510	15.03	-7.378	1.52	.31	.732	6.51	.52	.45	22.30
3T	16.30	.510	15.20	-9.097	1.17	.32	.774	6.81	.78	.45	22.30
4T	17.00	.510	15.91	-9.299	1.13	-.01	.788	7.22	.78	.45	22.30

AVERAGES: 60423 BASELINE W002 00 000

	22.88	.550	20.95	-7.276	1.68	-.70	.761	10.13	4.21	8.57	6.34
STD	.24	.000	.24	.955	.30	.45	.017	.18	.29	*	*

60423 W027CU-MN001 (1.7E15,1.3E15)

	16.87	.510	15.57	-7.984	1.38	-.40	.768	6.98	.78	.45	22.30
STD	.46	.000	.42	.632	.13	.47	.014	.26	.12	*	*

PERCENT OF BASELINE

	73.7	92.7	74.3	90.3	82	143.3	100.8	68.9	18.5	5.3	351.7
STD%	2.8	.1	2.9	24.2	24	146.2	4.1	3.8	4.3	.0	.3

60409A W028AL001 (2.6E16)

W002 00 000

\*SOL4 1 / 7 / 80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCDa	PCDb
1B.*	22.50	.540	19.86	-5.337	2.45	-1.86	.720	9.25	4.55	8.57	6.30
2B	22.75	.540	20.98	-7.691	1.49	-.45	.769	9.99	4.55	8.57	6.30
3B	22.75	.540	21.02	-7.717	1.49	-.71	.779	10.12	4.16	8.57	6.30
4B	22.75	.540	20.72	-6.830	1.74	-.71	.751	9.76	3.90	8.57	6.30
1C	17.00	.525	15.80	-8.389	1.32	-.56	.783	7.39	1.30	1.94	2.90
2C	17.00	.520	15.52	-7.141	1.62	-.73	.753	7.04	.91	1.94	2.90
3C	18.00	.530	16.70	-8.503	1.31	.04	.770	7.77	1.04	1.94	2.90
4C	18.40	.535	17.10	-8.740	1.28	.30	.768	7.99	1.30	1.94	2.90
1S	18.25	.530	17.06	-9.255	1.18	.27	.779	7.97	1.30	1.94	2.90
2S	18.25	.525	16.72	-7.356	1.56	-.62	.759	7.69	1.30	1.94	2.90
3S	18.25	.525	16.72	-7.356	1.56	-.62	.759	7.69	1.30	1.94	2.90
4S	18.30	.525	16.91	-8.033	1.39	-.26	.768	7.80	1.30	1.94	2.90

AVERAGES: 60409A BASELINE W002 00 000

	22.75	.540	20.91	-7.413	1.57	-.62	.767	9.96	4.20	8.57	6.30
STD	.00	.000	.14	.412	.12	.12	.011	.15	.27	*	*

60409A W028AL001 (2.6E16) AFTER SINTER

	17.93	.527	16.57	-8.097	1.40	-.27	.767	7.67	1.22	1.94	2.90
STD	.55	.004	.55	.709	.15	.40	.010	.30	.14	*	*

PERCENT OF BASELINE

	78.8	97.6	79.2	90.8	89	156.1	100.1	77.0	29.0	22.6	46.0
STD%	2.4	.8	3.2	16.2	17	84.5	2.8	4.2	5.5	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60611 W029CR003 (1.2E13) W025 00 000  
 \*SOL4 1 / 7 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	22.20	.541	20.75	-9.023	1.23	-.06	.787	9.99	5.20	12.74	7.60
2B	22.20	.541	20.75	-9.023	1.23	-.06	.787	9.99	5.20	12.74	7.60
3B	22.20	.541	20.75	-9.023	1.23	-.06	.787	9.99	5.20	12.74	7.60
4B	22.50	.541	20.91	-8.372	1.34	-.23	.778	10.02	5.20	12.74	7.60
5B	22.50	.541	21.25	-10.549	1.02	.40	.796	10.25	5.20	12.74	7.60
1C	23.00	.544	21.27	-7.915	1.45	-.38	.773	10.23	4.94	6.21	1.10
2C	23.00	.544	21.27	-7.915	1.45	-.38	.773	10.23	4.94	6.21	1.10
3C	23.20	.544	21.85	-10.116	1.07	.34	.792	10.57	5.46	6.21	1.10
4C	23.00	.544	21.27	-7.915	1.45	-.38	.773	10.23	5.20	6.21	1.10
1S	22.70	.542	21.10	-8.295	1.36	-.42	.784	10.20	5.20	6.21	1.10
2S	23.00	.542	21.45	-8.722	1.28	-.21	.786	10.36	5.20	6.21	1.10
3S	23.00	.542	21.45	-8.722	1.28	-.21	.786	10.36	5.46	6.21	1.10
1T	22.60	.540	21.30	-10.221	1.05	.35	.793	10.24	5.46	6.21	1.10
2T	23.00	.540	21.49	-8.894	1.24	-.21	.790	10.37	5.20	6.21	1.10
3T	23.00	.540	21.49	-8.894	1.24	-.21	.790	10.37	5.20	6.21	1.10
4T	22.60	.540	21.11	-9.104	1.21	.18	.780	10.06	3.90	6.21	1.10
AVERAGES: 60611 BASELINE W025 00 000											
	22.32	.541	20.88	-9.198	1.21	-.00	.787	10.05	5.20	12.74	7.60
STD	.15	.000	.19	.721	.11	.21	.006	.10	.00	*	*
60611 W029CR003 (1.2E13)											
	22.92	.542	21.37	-8.792	1.28	-.14	.784	10.29	5.11	6.21	1.10
STD	.18	.002	.20	.767	.13	.28	.007	.13	.42	*	*
PERCENT OF BASELINE											
	102.7	100.2	102.3	104.4	106	*****	99.6	102.4	98.2	48.7	14.5
STD%	1.5	.3	1.9	16.5	21	*****	1.7	2.3	8.1	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60510 W030CR-CU001 (1E15-1.7E15) W002 00 000  
 \*SOL4 1 /7 /80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OC	PCDa	PCDb
1B	22.00	.547	20.79	-10.668	1.01	.45	.797	10.14	4.94	8.57	6.30
2B	22.00	.547	20.47	-8.524	1.33	-.17	.780	9.92	4.94	8.57	6.30
3B	21.80	.547	20.41	-9.286	1.20	.05	.788	9.93	4.94	8.57	6.30
4B	22.00	.547	20.47	-8.524	1.33	-.17	.780	9.92	4.94	8.57	6.30
1C	16.00	.497	14.86	-8.731	1.20	.25	.768	6.46	.65	.42	.32
2C	15.60	.493	14.39	-8.154	1.30	.24	.754	6.14	.52	.42	.32
3C	16.50	.500	15.37	-8.968	1.16	.28	.772	6.74	.78	.42	.32
4C	17.20	.506	16.24	-10.848	.95	.89	.787	7.24	.91	.42	.32
5C	16.50	.500	15.37	-8.968	1.16	.28	.772	6.74	.65	.42	.32
1S	17.40	.510	16.31	-9.566	1.09	.17	.788	7.39	.91	.42	.30
2S	17.10	.510	16.06	-9.996	1.04	.53	.785	7.24	1.04	.42	.30
3S	17.40	.510	16.09	-8.182	1.33	-.05	.764	7.17	.91	.42	.30
2T	16.50	.500	15.33	-8.673	1.21	.16	.769	6.71	.65	.42	.30
3T	16.80	.500	15.65	-9.007	1.15	.28	.773	6.87	.78	.10	.30
AVERAGES: 60510 BASELINE W002 00 000											
	21.95	.547	20.53	-9.251	1.22	.64	.786	9.98	4.94	8.57	6.30
STD	.09	.000	.15	.875	.13	.26	.007	.09	.00	*	*
60510 W030CR-CU001 (1E15-1.7E15)											
	16.70	.503	15.57	-9.109	1.16	.31	.773	6.87	.78	.39	.31
STD	.57	.006	.60	.786	.11	.24	.010	.37	.15	*	*
PERCENT OF BASELINE											
	76.1	91.9	75.8	101.5	95	806.5	98.4	68.8	15.8	4.5	4.9
STD%	2.9	1.0	3.5	18.6	20	*****	2.2	4.4	3.1	1.1	.2

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60511 W031CR-MN001 (1E15-1.3E15) W002 00 000

\*SOL4 1 / 7 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	22.30	.550	20.71	-8.232	1.40	-.44	.782	10.14	4.55	8.57	6.30
2B*	22.30	.520	16.33	-2.905	6.80	-6.03	.543	6.66	.52	8.57	6.30
3B*	22.60	.500	16.06	-2.963	6.24	-3.13	.496	5.93	.26	8.57	6.30
4B	22.30	.550	21.13	-11.053	.98	.38	.805	10.44	5.20	8.57	6.30
1C	11.50	.465	10.67	-8.866	1.12	.56	.763	4.31	.39	.32	.00
2C*	12.20	.426	8.92	-3.295	5.09	-6.02	.525	2.89	.13	.32	.00
3C	12.80	.473	11.81	-7.972	1.30	-.77	.772	4.94	.13	.32	.00
4C	11.50	.465	10.73	-9.231	1.07	.23	.778	4.40	.13	.32	.00
5C	12.90	.473	11.87	-7.761	1.35	-.86	.768	4.96	.13	.32	.00
1S	12.60	.479	11.77	-9.467	1.06	.55	.776	4.95	.13	.32	.00
2S*	11.70	.445	8.73	-3.339	5.22	-8.01	.551	3.04	.13	.32	.00
3S	11.50	.470	10.70	-8.970	1.12	.18	.773	4.42	.13	.32	.00
1T	12.00	.470	11.15	-9.010	1.11	.77	.762	4.54	.13	.32	.00
2T	12.09	.470	11.15	-9.010	1.11	.77	.762	4.54	.13	.32	.00
3T*	13.20	.470	10.79	-4.137	3.47	-4.11	.627	4.12	.13	.32	.00
M1A2*	23.60	.573	21.92	-8.339	1.43	-.23	.778	11.13	5.85	.32	.00
M1A4*	23.60	.573	22.18	-9.844	1.16	.30	.789	11.29	5.20	.32	.00
C1A1*	21.40	.395	15.44	-4.794	2.11	5.92	.426	3.81	.14	.32	.00
C1A2*	22.20	.360	16.53	-5.482	1.57	5.60	.438	3.70	.14	.32	.00
AVERAGES: 60511 BASELINE W002 00 000											
	22.30	.550	20.92	-9.642	1.19	-.03	.793	10.29	4.88	8.57	6.30
STD	.00	.000	.21	1.411	.21	.41	.011	.15	.33	*	*
60511 W031CR-MN001 (1E15-1.3E15)											
	12.10	.471	11.23	-8.786	1.15	.18	.769	4.63	.16	.32	.00
STD	.56	.004	.49	.561	.10	.61	.006	.25	.09	*	*
PERCENT OF BASELINE											
	54.3	85.6	53.7	108.9	97	786.4	96.9	45.0	3.3	3.7	.0
STD%	2.5	.8	2.9	20.0	27	*****	2.2	3.2	2.1	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60607 W032MG003 (3.2E14) W003 00 000  
 \*SOL4 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	22.50	.552	21.08	-9.265	1.21	-.04	.791	10.39	4.94	8.42	11.60
2B	22.50	.552	21.08	-9.265	1.21	-.04	.791	10.39	4.94	8.42	11.60
3B	22.50	.552	21.08	-9.265	1.21	-.04	.791	10.39	5.20	8.42	11.60
4B	22.50	.552	21.08	-9.265	1.21	-.04	.791	10.39	5.20	8.42	11.60
5B	22.00	.548	20.51	-8.682	1.30	-.25	.786	10.02	3.51	8.42	11.60
1C	22.60	.549	21.17	-9.299	1.20	.07	.787	10.33	5.20	7.14	7.17
2C	22.60	.549	21.17	-9.299	1.20	.07	.787	10.33	3.90	7.14	7.17
3C	22.60	.549	21.17	-9.299	1.20	.07	.787	10.33	4.94	7.14	7.17
4C	22.60	.549	21.17	-9.299	1.20	.07	.787	10.33	5.20	7.14	7.17
5C	22.60	.549	20.88	-7.834	1.48	-.47	.773	10.15	4.68	7.14	7.17
1S	22.50	.545	21.14	-9.519	1.16	-.14	.799	10.36	5.20	7.14	7.20
2S	22.50	.545	20.80	-7.695	1.51	-.80	.781	10.13	5.20	7.14	7.20
3S	22.50	.545	20.80	-7.695	1.51	-.80	.781	10.13	4.94	7.14	7.20
1T	22.50	.550	20.99	-8.864	1.27	-.02	.782	10.24	5.20	7.14	7.20
2T	22.50	.550	20.99	-8.864	1.27	-.02	.782	10.24	4.55	7.14	7.20
3T	22.70	.550	21.09	-8.400	1.36	-.15	.776	10.25	4.55	7.14	7.20
4T	22.50	.550	20.99	-8.864	1.27	-.02	.782	10.24	3.90	7.14	7.20
AVERAGES: 60607 BASELINE W003 00 000											
	22.40	.551	20.96	-9.148	1.23	-.08	.790	10.31	4.76	8.42	11.60
STD	.20	.002	.23	.233	.04	.09	.002	.15	.63	*	*
60607 W032MG003 (3.2E14)											
	22.56	.548	21.03	-8.744	1.30	-.18	.784	10.25	4.79	7.14	7.19
STD	.06	.002	.14	.647	.12	.31	.006	.08	.47	*	*
PERCENT OF BASELINE											
	100.7	99.5	100.3	104.4	106	-19.3	99.3	99.4	100.6	84.8	62.0
STD%	1.2	.6	1.7	9.7	14	*****	1.0	2.2	24.5	.0	.2

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60608 W033TI002 (2E12) W003 00 000  
 \*SOL4 1 / 7 / 80 AMI: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	22.50	.555	21.29	-10.648	1.03	.17	.807	10.65	5.20	8.42	11.60
2B	22.25	.555	20.77	-8.964	1.27	.07	.781	10.20	4.55	8.42	11.60
3B	22.50	.555	21.02	-8.816	1.29	-.33	.792	10.46	4.55	8.42	11.60
4B	22.00	.555	20.66	-9.694	1.15	.24	.789	10.18	4.94	8.42	11.60
5B	22.25	.555	20.77	-8.964	1.27	.07	.781	10.20	4.29	8.42	11.60
1C	19.80	.535	18.60	-9.703	1.12	.06	.795	8.90	2.21	2.88	3.10
2C	20.20	.544	18.41	-7.003	1.71	-.61	.750	8.71	1.69	2.88	3.10
3C	19.60	.535	18.47	-10.313	1.04	.39	.794	8.80	2.21	2.88	3.10
4C	19.40	.535	18.09	-9.040	1.22	.33	.773	8.49	1.95	2.88	3.10
5C	19.60	.535	18.47	-10.313	1.04	.39	.794	8.80	2.34	2.88	3.10
1S	19.00	.534	17.94	-10.740	.99	.73	.790	8.48	2.21	2.88	3.10
2S	19.20	.534	18.01	-9.766	1.11	.48	.782	8.48	1.95	2.88	3.10
3S	19.20	.534	18.01	-9.766	1.11	.48	.782	8.48	2.21	2.88	3.10
1T	19.30	.537	17.96	-8.543	1.31	-.29	.782	8.57	1.95	2.88	3.10
2T	18.90	.537	17.65	-9.128	1.21	.15	.780	8.38	1.69	2.88	3.10
3T	19.60	.537	18.33	-9.153	1.20	-.03	.787	8.76	1.95	2.88	3.10
4T	19.60	.537	18.33	-9.153	1.20	-.03	.787	8.76	2.08	2.88	3.10
AVERAGES: 60608 BASELINE W003 00 000											
	22.30	.555	20.90	-9.417	1.20	.04	.790	10.34	4.71	8.42	11.60
STD	.19	.000	.23	.688	.10	.20	.009	.19	.32	*	*
60608 W033TI002 (2E12)											
	19.45	.536	18.19	-9.385	1.19	.17	.783	8.63	2.04	2.88	3.10
STD	.35	.003	.27	.941	.18	.36	.012	.17	.20	*	*
PERCENT OF BASELINE											
	87.2	96.6	87.0	100.3	99	383.2	99.1	83.5	43.3	34.2	26.7
STD%	2.3	.5	2.3	18.0	24	*****	2.7	3.2	7.5	.0	.0



TABLE 16 SOLAR CELL I-V DATA (Cont.)

60609 W035V002 (4E12) W003 00 000  
 \*SOL4 1 /7 /80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1B	23.25	.554	21.95	-10.270	1.07	.06	.805	10.96	5.46	8.42	11.60
2B	22.50	.554	21.10	-9.485	1.18	.15	.788	10.39	5.20	8.42	11.60
3B	22.50	.554	21.10	-9.485	1.18	.15	.788	10.39	5.20	8.42	11.60
4B	22.50	.554	21.10	-9.485	1.18	.15	.788	10.39	5.20	8.42	11.60
1C	18.30	.525	17.19	-9.843	1.08	.28	.790	8.02	1.30	1.45	1.16
2C*	18.20	.489	13.77	-3.304	5.18	-4.34	.555	5.22	.20	1.45	1.16
3C	18.00	.523	16.90	-9.877	1.07	.44	.786	7.82	1.04	1.45	1.16
4C	18.00	.523	16.90	-9.877	1.07	.44	.786	7.82	1.30	1.45	1.16
1S	18.20	.516	16.92	-8.630	1.25	.01	.774	7.69	1.30	1.45	1.20
2S	18.60	.521	17.36	-9.013	1.19	.10	.779	7.99	1.04	1.45	1.20
3S	18.60	.521	17.36	-9.013	1.19	.10	.779	7.99	1.30	1.45	1.20
1T	18.00	.525	16.91	-9.891	1.08	.33	.789	7.89	1.30	1.45	1.20
2T	18.00	.525	16.91	-9.891	1.08	.33	.789	7.89	1.30	1.45	1.20
3T	18.00	.525	16.91	-9.891	1.08	.33	.789	7.89	1.30	1.45	1.20
4T	18.00	.525	16.91	-9.891	1.08	.33	.789	7.89	1.30	1.45	1.20
AVERAGES: 60609 BASELINE W003 00 000											
	22.69	.554	21.31	-9.681	1.15	.13	.792	10.53	5.27	8.42	11.60
STD	.32	.000	.37	.340	.05	.04	.007	.25	.11	*	*
60609 W035V002 (4E12)											
	18.17	.523	17.03	-9.582	1.12	.27	.785	7.89	1.25	1.45	1.19
STD	.24	.003	.18	.466	.06	.14	.005	.09	.10	*	*
PERCENT OF BASELINE											
	80.1	94.4	79.9	101.0	97	208.7	99.1	74.9	23.7	17.2	10.2
STD%	2.2	.5	2.3	8.5	10	207.2	1.6	2.7	2.5	.0	.2

TABLE 16 SOLAR CELL (-V DATA (Cont.))

60714 W036ZR002 (<1.4E12) W025 00 000

\*SOL5 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.60	.554	20.35	-6.467	1.92	-.29	.723	9.57	.00	.00	.00
1B	22.20	.549	20.42	-7.490	1.57	-.53	.765	9.86	5.20	12.74	7.60
2B	22.40	.549	20.57	-7.385	1.60	-.54	.763	9.92	5.20	12.74	7.60
3B	22.50	.547	20.61	-7.185	1.65	-.68	.761	9.91	4.16	12.74	7.60
4B	22.50	.548	20.47	-6.766	1.79	-.81	.751	9.80	5.20	12.74	7.60
5B	22.80	.549	21.04	-7.794	1.49	-.30	.767	10.15	5.20	12.74	7.60
1C	19.90	.531	18.09	-6.922	1.70	-.44	.741	8.29	1.30	.97	1.20
2C	20.10	.529	18.20	-6.740	1.75	-.41	.734	8.26	1.30	.97	1.20
3C	20.20	.527	18.24	-6.595	1.80	-.46	.731	8.23	1.04	.97	1.20
4C	20.30	.523	17.79	-5.503	2.29	-.66	.687	7.72	1.04	.97	1.20
5C	20.00	.528	18.05	-6.545	1.82	-.57	.732	8.17	1.04	.97	1.20
1S	19.90	.531	17.94	-6.519	1.84	-.48	.728	8.13	1.04	.97	1.20
2S	20.10	.532	18.32	-7.136	1.63	-.26	.743	8.40	1.17	.97	1.20
3S	20.30	.526	17.95	-5.517	2.24	-1.22	.710	8.02	1.04	.97	1.20
1T	19.70	.528	17.78	-6.505	1.84	-.70	.734	8.07	1.04	.97	1.20
2T	20.20	.529	18.29	-6.664	1.78	-.60	.738	8.33	1.04	.97	1.20
3T	20.00	.527	17.98	-6.305	1.91	-.84	.730	8.14	1.04	.97	1.20
AVERAGES: 60714 BASELINE W025 00 000											
	22.48	.548	20.62	-7.324	1.62	-.57	.761	9.93	4.99	12.74	7.60
STD	.19	.001	.22	.341	.10	.17	.005	.12	.42	*	*
60714 W036ZR002 (<1.4E12)											
	20.06	.528	18.06	-6.459	1.87	-.60	.728	8.16	1.10	.97	1.20
STD	.18	.002	.18	.474	.20	.25	.015	.18	.10	*	*
PERCENT OF BASELINE											
	89.3	96.3	87.6	111.8	116	94.1	95.6	82.2	22.0	7.6	15.8
STDZ	1.6	.6	1.8	10.9	20	86.7	2.7	2.8	4.0	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60721 W037ZR-T1001 (7E11-2.2E14) W020 00 000  
 \*SOL5 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.556	20.28	-6.519	1.91	-.30	.725	9.59	.00	.00	.00
1B	22.70	.556	20.99	-7.902	1.48	-.38	.772	10.30	5.20	7.30	7.00
2B	22.70	.556	20.91	-7.507	1.58	-.70	.772	10.31	5.20	7.30	7.00
3B	22.60	.554	20.91	-7.925	1.47	-.45	.775	10.26	5.20	7.30	7.00
4B	23.10	.554	21.26	-7.529	1.57	-.52	.767	10.38	4.55	7.30	7.00
5B	23.00	.555	21.34	-8.201	1.41	-.32	.778	10.50	5.20	7.30	7.00
1C	13.90	.465	12.33	-6.197	1.79	-.06	.695	4.75	.13	.42	.50
2C	13.80	.464	12.25	-6.260	1.76	.07	.695	4.70	.13	.42	.50
3C	14.00	.463	12.40	-6.169	1.79	-.01	.693	4.75	.13	.42	.50
1S	13.30	.463	11.91	-6.667	1.61	.40	.703	4.58	.13	.42	.50
2S	13.90	.464	12.33	-6.188	1.79	-.06	.695	4.74	.13	.42	.50
3S	13.90	.463	12.27	-5.972	1.88	-.33	.691	4.70	.13	.42	.50
1T	13.80	.462	12.24	-6.199	1.78	-.10	.696	4.69	.13	.42	.50
2T	12.90	.456	10.99	-4.840	2.58	-2.65	.667	4.15	.13	.42	.50
3T	13.70	.458	11.96	-5.662	2.01	-.44	.677	4.49	.13	.42	.50
4T	13.50	.461	11.98	-6.256	1.76	.10	.693	4.56	.13	.42	.50
AVERAGES: 60/21 BASELINE W020 00 000											
	22.8	.555	21.08	-7.813	1.50	-.47	.773	10.35	5.07	7.30	7.00
STD	.19	.001	.18	.263	.06	.13	.004	.08	.26	*	*
60721 W037ZR-T1001 (7E11-1.6E14)											
	13.67	.462	12.07	-6.041	1.88	-.31	.690	4.61	.13	.42	.50
STD	.33	.003	.39	.465	.25	.81	.010	.18	.00	*	*
PERCENT OF BASELINE											
	59.9	83.2	57.2	122.7	125	134.8	89.3	44.6	2.6	5.8	7.1
STDZ	1.9	.6	2.4	8.8	23	236.5	1.7	2.1	.1	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60803 W038AL002 (6E16) W020 00 000

\*SOL5 1 / 7 / 80 AM!: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.31	-6.595	1.87	-.23	.726	9.59	.00	.00	.00
1B	22.60	.554	20.42	-6.383	1.95	-1.02	.744	9.85	4.29	7.30	7.00
2B	22.60	.555	20.95	-8.148	1.43	-.29	.775	10.28	4.55	7.30	7.00
3B	22.60	.553	20.54	-6.693	1.83	-.86	.750	9.92	4.55	7.30	7.00
4B	22.90	.555	21.10	-7.692	1.53	-.29	.763	10.26	4.55	7.30	7.00
5B	22.70	.555	20.82	-7.318	1.63	-.53	.760	10.13	4.29	7.30	7.00
1C	17.90	.520	16.20	-6.857	1.70	-.16	.728	7.17	.52	.15	.70
2C	18.10	.518	16.07	-5.985	2.04	-.52	.703	6.97	.39	.15	.70
3C	18.40	.519	16.37	-5.976	2.04	-.83	.712	7.19	.26	.15	.70
4C	18.10	.521	16.28	-6.511	1.82	-.37	.722	7.20	.13	.15	.70
1S	17.80	.520	15.92	-6.202	1.95	-.71	.718	7.03	.13	.15	.70
2S	18.00	.522	16.37	-7.120	1.62	-.11	.736	7.31	.13	.15	.70
3S	18.00	.520	16.05	-6.726	1.74	-.22	.726	7.18	.39	.15	.70
1T	18.00	.524	16.35	-7.016	1.66	-.20	.735	7.33	.26	.15	.70
2T	17.80	.519	15.97	-6.393	1.87	-.43	.718	7.02	.26	.15	.70
3T	17.80	.520	16.07	-6.694	1.76	-.33	.727	7.12	.26	.15	.70
4T	18.30	.519	16.38	-6.298	1.90	-.46	.716	7.19	.39	.15	.70
AVERAGES: 60803 BASFLINE W020 00 000											
	22.68	.554	20.77	-7.247	1.68	-.60	.759	10.09	4.45	7.30	7.00
STD	.12	.001	.25	.643	.19	.30	.011	.18	.13	*	*
60803 W038AL002 (6E16)											
	18.02	.520	16.20	-6.525	1.83	-.39	.722	7.16	.28	.15	.70
STD	.19	.002	.16	.374	.14	.22	.009	.11	.12	*	*
PERCENT OF BASELINE											
	79.4	93.8	78.0	110.0	109	134.1	95.2	70.9	6.4	2.1	10.0
STDZ	1.3	.4	1.7	13.6	22	86.9	2.6	2.3	3.0	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60805 W039NI003 (TWINNED) (3.3E16) W020 00 000  
 \*SOL5 1 / 7 / 80 AMI: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.553	20.27	-6.492	1.91	-.30	.724	9.53	.00	.00	.00
1B	22.60	.558	21.03	-8.584	1.34	-.07	.778	10.37	5.46	7.30	7.00
2B*	22.20	.555	20.54	-7.968	1.47	-.40	.774	10.08	5.20	7.30	7.00
3B	22.70	.553	20.94	-7.722	1.52	-.45	.770	10.22	5.20	7.30	7.00
4B	22.60	.553	21.00	-8.384	1.37	-.26	.780	10.30	5.20	7.30	7.00
1C	21.90	.549	20.12	-7.401	1.60	-.60	.764	9.72	4.81	6.50	2.00
2C	21.80	.549	20.12	-7.765	1.50	-.43	.769	9.74	4.81	6.50	2.00
3C.*	20.80	.529	16.72	-3.777	4.21	-2.93	.607	7.07	.91	6.50	2.00
1S	22.10	.548	20.35	-7.694	1.52	-.28	.763	9.77	4.03	6.50	2.00
2S.*	22.00	.543	18.61	-4.203	3.56	-3.72	.684	8.64	3.12	6.50	2.00
3S	22.00	.546	19.79	-6.168	2.02	-1.13	.737	9.37	3.51	6.50	2.00
1T.*	20.00	.480	12.17	-6.990	1.52	15.68	.320	3.25	.13	6.50	2.00
3T.*	20.70	.517	13.89	-3.368	5.10	3.55	.416	4.70	.13	6.50	2.00
4T.*	20.60	.507	13.30	-4.155	3.43	9.48	.367	4.06	.13	6.50	2.00
AVERAGES: 60805 BASELINE W020 00 000											
	22.63	.555	20.99	-8.230	1.41	-.26	.776	10.30	5.29	7.30	7.00
STD	.05	.002	.04	.368	.08	.15	.004	.06	.12	*	*
60805 W039NI003 (TWINNED) (3.3E16)											
	21.95	.548	20.09	-7.257	1.66	-.61	.758	9.65	4.29	6.50	2.00
STD	.11	.001	.20	.643	.21	.32	.012	.16	.55	*	*
PERCENT OF BASELINE											
	97.0	98.8	95.7	111.8	118	-36.7	97.8	93.7	81.1	84.0	28.6
STD%	.7	.6	1.1	12.1	22	338.6	2.2	2.2	12.6	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60811 W040CR-NI001 (8E14-1.3E16) W020 00 000  
 \*SOL5 1 / 7 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.556	20.31	-6.639	1.86	-.14	.721	9.58	.00	.00	.00
1B	22.60	.553	20.75	-7.356	1.62	-.59	.764	10.09	4.16	7.30	7.00
2B	22.70	.555	20.99	-7.951	1.47	-.29	.770	10.26	4.94	7.30	7.00
3B	22.50	.559	20.93	-8.476	1.37	-.20	.780	10.37	4.94	7.30	7.00
4B	22.50	.556	20.91	-8.374	1.38	-.30	.781	10.33	4.94	7.30	7.00
5B	23.10	.553	21.00	-6.694	1.83	-.85	.751	10.15	3.90	7.30	7.00
1C	20.40	.531	18.61	-7.064	1.65	-.51	.749	8.58	1.30	1.35	.20
2C	20.80	.532	18.89	-6.709	1.77	-.84	.748	8.75	1.43	1.35	.20
3C	20.80	.528	18.82	-6.500	1.83	-.97	.744	8.65	1.17	1.35	.20
4C	20.40	.527	18.45	-6.479	1.84	-.98	.743	8.45	1.30	1.35	.20
5C	20.20	.519	18.01	-5.843	2.09	-1.32	.725	8.04	.65	1.35	.20
1S	20.30	.523	17.97	-5.574	2.25	-1.55	.718	8.06	1.04	1.35	.20
2S	21.50	.537	19.64	-7.077	1.66	-.64	.755	9.22	1.95	1.35	.20
3S	21.50	.534	19.61	-7.020	1.67	-.51	.749	9.10	1.69	1.35	.20
1T	18.50	.501	16.48	-5.994	1.96	-.85	.715	7.01	.39	1.35	.20
2T	17.80	.493	15.85	-6.074	1.90	-.58	.709	6.58	.26	1.35	.20
3T	17.40	.488	15.49	-6.108	1.87	-.44	.706	6.34	.26	1.35	.20
4T	16.70	.485	14.97	-6.460	1.73	-.23	.714	6.12	.26	1.35	.20
AVERAGES: 60811 BASELINE W020 00 000											
	22.68	.555	20.92	-7.770	1.53	-.45	.769	10.24	4.58	7.30	7.00
STD	.22	.002	.09	.667	.17	.24	.011	.11	.45	*	*
60811 W040CR-NI001 (8E14-1.3E16)											
	19.69	.517	17.73	-6.408	1.85	-.79	.731	7.91	.98	1.35	.20
STD	1.58	.018	1.55	.478	.17	.36	.018	1.06	.57	*	*
PERCENT OF BASELINE											
	86.8	93.0	84.8	117.5	121	23.7	95.1	77.2	21.3	18.5	2.9
STDX	7.9	3.7	7.8	13.8	26	221.4	3.7	11.2	15.8	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60809 W041CR-CU-NI001 (8E14-1.7E15-i.3E16) W020 00 000  
 \*SOL5 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.553	20.30	-6.577	1.87	-.23	.725	9.54	.00	.00	.00
2B	23.10	.553	21.53	-8.666	1.31	-.19	.784	10.59	5.20	.00	.00
3B.*	22.60	.548	20.20	-5.845	2.18	-1.38	.732	9.59	3.25	.00	.00
4B	22.70	.552	21.07	-8.204	1.41	-.37	.779	10.33	4.81	.00	.00
5B	22.90	.552	21.21	-8.046	1.44	-.39	.776	10.38	4.94	.00	.00
1C	19.30	.503	16.73	-5.066	2.51	-1.55	.685	7.03	.65	.43	.20
2C	20.80	.527	18.74	-6.297	1.91	-1.01	.737	8.55	1.30	.43	.20
3C	19.00	.507	16.84	-5.725	2.12	-1.20	.713	7.26	.52	.43	.20
4C.*	20.20	.505	14.93	-2.911	5.79	-7.81	.562	6.07	.26	.43	.20
1S	19.30	.509	16.84	-5.135	2.49	-1.96	.701	7.28	.52	.43	.20
2S	20.50	.523	18.32	-5.948	2.05	-1.23	.728	8.26	.91	.43	.20
3S	20.30	.518	17.61	-4.887	2.71	-2.41	.700	7.79	.78	.43	.20
1T	18.20	.495	15.73	-5.081	2.47	-1.35	.677	6.45	.39	.43	.20
2T	17.70	.502	15.66	-5.779	2.08	-.93	.704	6.62	.39	.43	.20
3T	17.70	.498	15.53	-5.464	2.24	-1.33	.698	6.51	.52	.43	.20
4T	16.90	.496	14.94	-5.859	2.03	-.66	.699	6.20	.52	.43	.20
AVERAGES: 60809 BASELINE W020 00 000											
	22.90	.552	21.27	-8.305	1.39	-.31	.780	10.43	4.98	.00	.00
STD	.16	.000	.19	.263	.05	.09	.003	.11	.16	*	*
60809 W041CR-CU-NI001 (8E14-1.7E15-1.3E16)											
	18.97	.508	16.69	-5.524	2.26	-1.36	.704	7.19	.65	.43	.20
STD	1.26	.011	1.19	.443	.25	.48	.017	.75	.27	*	*
PERCENT OF BASELINE											
	82.8	91.9	78.5	133.5	163	*****	90.3	69.0	13.0	*****	*****
STDZ	6.1	2.0	6.4	7.6	25	322.5	2.6	8.1	5.9	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60820 W042TI003 (4E13) W020 00 000

\*SOL5 1 / 7 / 80 AMI: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.37	-6.775	1.81	-.11	.728	9.62	.00	.00	.00
1B	22.90	.555	21.06	-7.486	1.59	-.46	.753	10.26	4.16	7.30	7.00
2B	22.30	.559	20.58	-7.812	1.52	-.33	.768	10.12	4.16	7.30	7.00
3B.*	22.60	.555	20.23	-5.899	2.18	-1.38	.734	9.74	4.16	7.30	7.00
4B	22.80	.556	20.99	-7.577	1.56	-.44	.765	10.26	4.55	7.30	7.00
5B	22.80	.555	21.13	-8.187	1.42	-.17	.772	10.33	4.55	7.30	7.00
1C	16.20	.493	14.15	-5.458	2.25	-1.12	.688	5.81	1.20	.71	.80
2C	16.10	.495	14.25	-5.993	1.97	-.35	.696	5.87	1.20	.71	.80
3C	16.30	.496	14.73	-6.987	1.59	.33	.718	6.14	1.20	.71	.80
4C	16.30	.495	14.53	-6.248	1.85	-.28	.706	6.02	1.20	.71	.80
5C.*	16.30	.486	12.85	-3.484	4.76	-6.53	.613	5.13	1.20	.71	.80
1S	16.60	.494	14.53	-5.532	2.20	-.92	.638	5.97	.26	.71	.80
2S	16.70	.493	14.73	-5.810	2.04	-.63	.696	6.06	.13	.71	.80
3S	16.60	.495	14.69	-5.923	2.00	-.57	.699	6.08	.13	.71	.80
1T	16.40	.492	14.43	-5.740	2.08	-.63	.691	5.90	.13	.71	.80
2T	16.20	.493	14.24	-5.657	2.13	-.90	.693	5.86	.13	.71	.80
3T	16.40	.493	14.48	-5.839	2.03	-.60	.696	5.95	.13	.71	.80
4T	16.50	.492	14.42	-5.515	2.20	-.81	.684	5.87	.13	.71	.80
AVERAGES: 60820 BASELINE W020 00 000											
	22.70	.550	20.94	-7.766	1.52	-.35	.767	10.24	4.36	7.30	7.00
STD	.23	.002	.21	.271	.07	.12	.003	.08	.19	*	*
60820 W042TI003 (4E13)											
	16.39	.494	14.47	-5.882	2.03	-.59	.696	5.96	.53	.71	.80
STD	.18	.001	.19	.414	.18	.37	.009	.10	.51	*	*
PERCENT OF BASELINE											
	72.2	88.8	69.1	124.3	134	32.2	90.7	58.2	12.2	9.7	11.4
STD%	1.6	.5	1.6	8.2	18	198.1	1.6	1.4	12.7	.0	.0



TABLE 16 SOLAR CELL I-V DATA (Cont.)

60823 W043FE-TI001 (5.6E14-3.3E13) W020 00 000  
 \*SOL5 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.28	-6.544	1.89	-.21	.723	9.55	.00	.00	.00
1B	23.00	.556	21.20	-7.668	1.54	-.42	.767	10.38	4.16	7.30	7.00
2B	22.80	.555	21.05	-7.800	1.51	-.40	.770	10.31	4.94	7.30	7.00
3B	22.70	.555	20.57	-6.474	1.92	-1.06	.749	9.98	3.90	7.30	7.00
4B	22.80	.554	20.58	-6.247	2.01	-1.27	.747	9.98	4.81	7.30	7.00
5B	23.50	.555	21.73	-7.981	1.46	-.24	.770	10.62	4.55	7.30	7.00
1C	16.10	.493	14.40	-6.353	1.81	-.35	.712	5.98	.13	.50	.90
2C	15.90	.490	14.29	-6.678	1.68	.12	.712	5.87	.13	.50	.90
3C	16.20	.487	14.34	-5.983	1.94	-.42	.698	5.82	.13	.50	.90
4C	16.30	.488	14.36	-5.797	2.03	-.51	.691	5.81	.13	.50	.90
5C	16.00	.481	13.86	-5.199	2.36	-1.48	.681	5.54	.13	.50	.90
1S	16.30	.490	14.10	-5.137	2.44	-1.58	.680	5.74	.13	.50	.90
2S	16.20	.489	14.16	-5.464	2.22	-1.16	.689	5.78	.13	.50	.90
3S	16.20	.486	13.74	-4.665	2.82	-2.27	.661	5.50	.13	.50	.90
1T	16.00	.484	14.25	-6.238	1.82	-.21	.704	5.76	.13	.50	.90
2T	16.10	.484	14.30	-6.125	1.87	-.28	.700	5.77	.13	.50	.90
3T	16.20	.488	14.42	-6.200	1.85	-.27	.704	5.88	.13	.50	.90
4T	16.20	.488	14.37	-6.037	1.92	-.46	.701	5.86	.13	.50	.90

AVERAGES: 60823 BASELINE W020 00 000

	22.96	.555	21.03	-7.234	1.69	-.68	.761	10.25	4.47	7.30	7.00
STD	.29	.001	.43	.724	.23	.41	.010	.25	.39	*	*
	60823 W043FE-TI001 (5.6E14-3.3E13)										
	16.14	.487	14.22	-5.823	2.06	-.74	.694	5.78	.13	.50	.90
STD	.12	.003	.21	.564	.32	.68	.014	.13	.00	*	*
PERCENT OF BASELINE	70.3	87.8	67.6	119.5	122	90.8	91.3	56.4	2.9	6.8	12.9
STD%	1.4	.7	2.4	16.6	38	227.2	3.2	2.6	.3	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60827 W044FE003 (1.7E13) W020 00 000  
 \*SOL3 1 / 7 / 80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	V <sub>SC</sub>	V <sub>OC</sub>	I <sub>P</sub>	LOG(I <sub>O</sub> )	N	R	FF	Eff	OCD	PCD <sub>a</sub>	PCD <sub>b</sub>
1R*	22.50	.555	20.78	-8.308	1.39	.61	.747	9.87	.00	.00	.00
1B	22.80	.553	20.89	-7.319	1.63	-.35	.755	10.06	3.25	7.30	7.00
2B	23.30	.556	21.87	-9.523	1.18	.05	.792	10.86	4.94	7.30	7.00
3B	23.10	.556	21.52	-8.676	1.32	-.06	.780	10.59	4.29	7.30	7.00
4B	23.10	.555	21.45	-8.354	1.38	-.14	.775	10.51	4.55	7.30	7.00
5B	23.50	.557	21.67	-7.821	1.50	-.12	.761	10.54	4.42	7.30	7.00
1C.*	22.70	.551	18.92	-3.744	4.38	-5.90	.694	9.18	2.99	6.59	1.26
2C.*	23.10	.553	20.04	-4.637	3.08	-3.33	.718	9.71	3.38	6.59	1.26
3C	23.30	.558	21.67	-8.461	1.37	-.15	.778	10.70	5.20	6.59	1.26
4C*	22.80	.539	17.93	-3.297	5.41	-5.48	.613	7.97	1.30	6.59	1.26
1S	23.10	.559	21.73	-9.849	1.14	.20	.793	10.83	4.94	6.59	1.26
2S	23.00	.554	21.48	-8.957	1.26	.03	.782	10.54	3.90	6.59	1.26
3S	24.20	.551	22.30	-8.134	1.41	.61	.743	10.47	3.25	6.59	1.26
1T	22.50	.557	21.14	-9.799	1.14	.27	.790	10.46	4.29	6.59	1.26
2T.*	22.70	.551	19.47	-4.298	3.47	-4.32	.715	9.46	2.99	6.59	1.26
3T	22.90	.556	21.38	-8.979	1.27	.05	.782	10.53	4.42	6.59	1.26
AVERAGES: 60827 BASELINE W020 00 000											
	23.16	.555	21.48	-8.338	1.40	-.12	.773	10.51	4.29	7.30	7.00
STD	.23	.001	.03	.752	.15	.13	.013	.26	.56	*	*
60827 W044FE003 (1.7E13)											
	23.17	.556	21.62	-9.030	1.26	.17	.778	10.59	4.33	6.59	1.26
STD	.52	.003	.36	.632	.10	.24	.017	.13	.64	*	*
PERCENT OF BASELINE											
	100.0	100.1	100.6	91.7	90	334.0	100.7	100.7	101.0	90.3	18.0
STD%	3.3	.7	3.2	18.0	18	534.7	3.9	3.7	30.3	.1	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

61019 W045CR-FE-TI001 (6.5E14-4.3E14-3.9E13) W020 00 000  
 \*SOL3 1 / 7 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.44	-6.975	1.74	-.03	.732	9.67	.00	.00	.00
1B	22.50	.544	19.23	-4.564	3.12	-2.30	.679	8.79	1.56	7.30	6.99
2B	22.70	.554	21.04	-8.117	1.43	-.35	.777	10.33	5.20	7.30	6.99
3B	22.70	.555	21.04	-8.163	1.42	-.28	.775	10.33	4.55	7.30	6.99
4B	22.80	.555	21.01	-7.605	1.55	-.55	.770	10.30	4.29	7.30	6.99
5B	22.70	.553	20.99	-7.815	1.50	-.56	.776	10.30	4.29	7.30	6.99
1C	15.50	.484	14.21	-7.652	1.38	-.07	.749	5.94	.13	.99	.15
2C	16.20	.486	14.91	8.004	1.31	.23	.751	6.25	.13	.99	.15
3C	16.20	.490	14.83	-7.400	1.46	-.48	.754	6.33	.13	.99	.15
4C	15.70	.478	14.07	-6.162	1.83	-1.42	.74	5.80	.13	.99	.15
5C	15.80	.481	14.39	-7.090	1.52	-.63	.74	5.01	.13	.99	.15
1S	15.60	.480	14.11	-6.641	1.66	-1.01	.741	5.86	.13	.99	.15
2S	16.10	.487	14.71	-7.267	1.49	-.55	.751	6.23	.13	.99	.15
3S	16.20	.489	14.83	-7.388	1.46	-.48	.753	6.31	.13	.99	.15
1T	16.30	.487	14.95	-7.675	1.38	-.02	.749	6.29	.13	.99	.15
2T	16.30	.487	14.95	-7.675	1.38	-.02	.749	6.29	.13	.99	.15
3T	16.20	.486	14.90	-7.818	1.35	-.14	.756	6.30	.13	.99	.15
4T	16.20	.487	14.83	-7.470	1.43	-.24	.749	6.25	.13	.99	.15
AVERAGES: 61019 BASELINE W020 00 000											
	22.73	.554	21.02	-7.925	1.48	-.44	.774	10.32	4.58	7.30	6.99
STD	.05	.001	.02	.228	.05	.13	.003	.01	.37	*	*
61019 W045CR-FE-TI001 (6.5E14-4.3E14-3.9E13)											
	16.52	.490	14.99	-7.139	1.60	-.55	.743	6.36	.24	1.48	.68
STD	1.75	.016	1.26	.883	.46	.66	.020	.72	.38	*	*
PERCENT OF BASELINE											
	72.7	88.4	71.3	109.9	108	73.9	96.0	61.6	5.2	20.2	9.7
STD%	7.8	3.0	6.1	14.1	36	232.1	2.9	7.1	9.4	23.0	26.1

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60902 W046FE-V001 (5.7E14-7E13) W020 00 000

\*SOL3 1 / 7 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.54	-7.237	1.66	-.04	.741	9.79	.00	.00	.00
1B	22.60	.558	21.13	-9.001	1.27	-.15	.790	10.53	4.42	7.30	7.00
2B	22.80	.560	21.47	-10.118	1.10	.31	.793	10.71	5.20	7.30	7.00
3B	22.70	.558	21.27	-9.440	1.20	.22	.785	10.52	4.16	7.30	7.00
4B	22.80	.559	21.47	-10.103	1.10	.31	.793	10.69	4.94	7.30	7.00
5B	22.80	.556	21.19	-8.446	1.36	-.10	.776	10.40	4.16	7.30	7.00
1C*	9.90	.480	8.15	-4.280	3.52	-6.38	.640	3.22	.10	.15	.15
2C	18.00	.499	16.83	-9.299	1.10	.24	.780	7.41	.65	.15	.15
3C	17.50	.496	15.85	-6.537	1.73	-1.33	.750	6.88	.65	.15	.15
4C	17.40	.496	15.89	-7.037	1.57	-1.02	.759	6.93	.65	.15	.15
5C	17.40	.493	15.93	-7.379	1.47	-.48	.755	6.85	.65	.15	.15
1S	17.70	.498	16.40	-8.284	1.27	-.19	.771	7.19	.39	.15	.15
2S	17.50	.498	16.21	-8.202	1.29	-.31	.773	7.12	.39	.15	.15
3S	17.60	.495	16.21	-7.710	1.39	-.55	.767	7.07	.52	.15	.15
1T	17.80	.500	16.52	-8.516	1.23	.06	.769	7.24	.52	.15	.15
2T	17.10	.497	15.62	-6.984	1.59	-1.31	.765	6.88	.52	.15	.15
3T	17.20	.496	15.66	-6.808	1.64	-1.32	.759	6.85	.52	.15	.15
4T	17.10	.496	15.83	-8.240	1.28	-.14	.769	6.89	.52	.15	.15

AVERAGES: 60902 BASELINE W020 00 000

	22.74	.558	21.31	-9.422	1.21	.12	.787	10.57	4.58	7.30	7.00
STD	.08	.001	.14	.645	.10	.20	.007	.12	.42	*	*
	60902 W046FE-V001 (5.7E14-7E13)										
	17.48	.497	16.09	-7.727	1.42	-.58	.765	7.03	.54	.15	.15
STD	.27	.002	.36	.815	.19	.55	.008	.18	.09	*	*
	PERCENT OF BASELINE										
	76.9	89.0	75.5	118.0	117	*****	97.2	66.5	11.9	2.1	2.1
STDZ	1.5	.5	2.2	14.9	27	*****	1.9	2.5	3.3	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

61026 W047CU-NI-ZR001 (1.7E15-4.7E15-2.1E11) W020 00 000  
 \*SOL3 1 /7 /80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.557	20.45	-6.974	1.75	-.10	.735	9.73	.00	.00	.00
1B.*	22.90	.556	20.55	-5.949	2.16	-1.50	.741	9.98	3.25	7.30	7.00
2B	23.00	.558	21.37	-8.418	1.37	-.16	.777	10.55	4.55	7.30	7.00
4B	22.80	.559	21.14	-8.107	1.44	-.40	.778	10.49	4.55	7.30	7.00
5B	22.90	.560	21.41	-9.032	1.27	-.04	.786	10.66	4.55	7.30	7.00
1C	21.60	.545	19.51	-6.141	2.03	-1.88	.759	9.45	1.95	2.61	3.37
2C	21.50	.545	19.99	-8.656	1.30	.19	.770	9.54	1.95	2.61	3.37
3C	21.50	.543	19.83	-7.863	1.46	-.17	.763	9.42	1.95	2.61	3.37
4C	21.70	.543	20.08	-8.119	1.41	-.15	.769	9.58	1.95	2.61	3.37
1S	21.30	.543	19.41	-6.883	1.74	-.83	.754	9.23	1.95	2.61	3.37
2S	21.50	.544	19.99	-8.533	1.32	-.03	.775	9.58	1.95	2.61	3.37
3S	21.60	.543	20.01	-8.236	1.38	-.02	.767	9.52	1.95	2.61	3.37
1T	21.20	.543	19.65	-8.283	1.37	-.07	.770	9.37	1.95	2.61	3.37
2T	21.40	.543	19.91	-8.687	1.29	.12	.773	9.50	1.95	2.61	3.37
3T	21.40	.543	19.96	-8.987	1.24	.26	.775	9.52	1.95	2.61	3.37
4T	21.60	.543	20.11	-8.852	1.26	.28	.771	9.56	1.95	2.61	3.37
AVER. RES: 61026 BASELINE W020 00 000											
	22.90	.559	21.31	-8.519	1.36	-.20	.781	10.57	4.55	7.30	7.00
STD	.08	.001	.12	.384	.07	.15	.004	.07	.00	*	*
61026 W047CU-NI-ZR001 (1.7E15-4.7E15-2.1E11)											
	21.48	.543	19.86	-8.113	1.44	-.21	.768	9.48	1.95	2.61	3.37
STD	.14	.001	.22	.832	.23	.60	.006	.10	.00	*	*
PERCENT OF BASELINE											
	93.8	97.2	93.2	104.8	106	94.6	98.4	89.7	42.9	35.8	48.1
STD%	1.0	.3	1.6	14.5	23	605.0	1.3	1.6	.0	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

60914 W048T1004 (2E11) W002 00 000

\*SOL3 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.59	-7.402	1.61	.03	.744	9.82	.00	.00	.00
1B.*	23.70	.558	21.22	-5.870	2.20	-1.38	.736	10.29	3.25	8.57	6.34
2B	23.10	.556	20.79	-6.096	2.08	-1.33	.743	10.09	3.25	8.57	6.34
3B.*	22.90	.554	20.60	-6.035	2.11	-1.49	.745	10.00	3.25	8.57	6.34
4B	22.80	.558	21.08	-7.923	1.48	-.33	.771	10.37	4.29	8.57	6.34
5B	23.00	.558	21.50	-9.020	1.26	-.06	.787	10.68	5.20	8.57	6.34
1C	22.70	.552	20.82	-7.217	1.65	-.78	.766	10.15	3.64	5.09	4.30
2C	22.70	.552	20.98	-7.835	1.49	-.49	.774	10.26	4.29	5.09	4.30
3C*	22.90	.541	18.41	-3.302	5.41	-7.19	.660	8.65	1.95	5.09	4.30
4C	22.90	.550	20.74	-6.374	1.94	-1.31	.754	10.05	3.90	5.09	4.30
1S	22.50	.551	20.56	-6.882	1.76	-1.09	.765	10.03	3.90	5.09	4.30
2S	22.70	.550	20.65	-6.736	1.80	-.83	.751	9.92	3.38	5.09	4.30
3S	22.80	.551	21.07	-7.855	1.48	-.38	.771	10.24	3.90	5.09	4.30
1T	22.70	.551	21.04	-8.137	1.42	-.32	.776	10.27	4.16	5.09	4.30
2T	22.70	.552	21.20	-8.973	1.26	.01	.783	10.38	4.16	5.09	4.30
3T	22.80	.551	21.07	-7.855	1.48	-.38	.771	10.24	4.29	5.09	4.30
4T	22.40	.549	20.75	-8.117	1.42	-.23	.772	10.04	4.03	5.09	4.30
AVERAGES: 60914 BASELINE W002 00 000											
	22.97	.557	21.12	-7.680	1.61	-.57	.767	10.38	4.25	8.57	6.34
STD	.12	.001	.29	1.206	.35	.55	.018	.24	.80	*	*
60914 W048T1004 (2E11)											
	22.69	.551	20.89	-7.598	1.57	-.58	.768	10.16	3.97	5.09	4.30
STD	.14	.001	.20	.744	.20	.39	.009	.14	.27	*	*
PERCENT OF BASELINE											
	98.8	98.8	98.9	101.1	98	98.3	100.2	97.9	93.4	59.4	67.8
STD%	1.1	.3	2.3	26.7	36	230.6	3.6	3.6	25.2	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

61022 W049V003 (4E11) W020 00 000

\*SOL3 1 / 7 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.54	-7.331	1.63	.20	.736	9.72	.00	.00	.00
1B.*	22.30	.553	18.40	-3.477	5.04	-7.99	.703	9.17	2.60	7.30	7.00
2B*	22.50	.548	18.01	-3.378	5.27	-0.18	.641	8.35	1.82	7.30	7.00
3B*	22.30	.549	18.28	-3.515	4.91	-6.83	.680	8.80	2.08	7.30	7.00
4B	22.40	.556	20.61	-7.434	1.61	-.70	.769	10.13	3.51	7.30	7.00
1C.*	22.20	.543	17.92	-3.286	5.52	-8.24	.675	8.61	1.82	4.33	3.68
2C*	22.00	.537	17.28	-3.403	5.12	-4.48	.599	7.49	1.17	4.32	3.68
3C	22.20	.549	19.88	-5.765	2.23	-1.96	.745	9.61	2.86	4.32	3.68
4C	22.40	.549	19.99	-5.619	2.31	-2.07	.742	9.65	3.25	4.32	3.68
5C	22.40	.549	20.80	-8.382	1.36	-.15	.776	10.09	3.25	4.32	3.68
1S	22.40	.551	20.81	-8.406	1.36	-.15	.776	10.13	3.25	4.32	3.68
2S*	22.10	.537	17.65	-3.369	5.21	-6.16	.638	8.00	1.30	4.32	3.68
3S.*	22.30	.549	19.58	-4.951	2.78	-3.16	.734	9.50	2.99	4.32	3.68
1T	22.40	.549	20.45	-6.951	1.73	-.79	.757	9.85	3.12	4.32	3.68
2T	22.40	.550	20.58	-7.418	1.59	-.56	.764	9.96	3.12	4.32	3.68
3T.*	22.30	.541	17.98	-3.345	5.31	-7.26	.663	8.46	1.56	4.32	3.68
4T.*	22.20	.546	18.70	-3.844	4.16	-6.17	.712	9.13	2.34	4.32	3.68
AVERAGES: 61022 BASELINE W020 00 000											
	22.40	.556	20.61	-7.434	1.61	-.70	.769	10.13	3.51	7.30	7.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
61022 W049V003 (4E11)											
	22.37	.550	20.42	-7.090	1.76	-.95	.760	9.88	3.14	4.32	3.68
STD	.07	.001	.37	1.114	.38	.79	.013	.20	.14	*	*
PERCENT OF BASELINE											
	99.9	98.8	99.1	104.6	110	64.8	98.8	97.5	89.5	59.2	52.6
STDZ	.3	.1	1.8	15.0	24	112.3	1.7	2.0	4.0	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

61020 W050TI-V001 (2E11-4E11) W020 00 000

\*SOL3 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.557	20.64	-7.745	1.53	.46	.739	9.79	.00	.00	.00
1B	23.20	.562	21.64	-8.844	1.30	.01	.781	10.76	5.20	7.30	6.99
2B	23.30	.563	21.83	-9.382	1.21	.19	.785	10.89	5.46	7.30	6.99
3B	23.60	.560	21.78	-7.790	1.52	-.34	.768	10.74	4.94	7.30	6.99
4B	23.30	.560	21.75	-8.943	1.28	.09	.780	10.76	4.94	7.30	6.99
5B	23.60	.561	22.03	-8.918	1.29	.06	.781	10.93	5.20	7.30	6.99
1C	20.60	.527	18.78	-6.927	1.68	-.77	.753	8.65	.78	1.07	1.06
2C	20.30	.526	18.69	-7.662	1.47	-.38	.763	8.62	.78	1.07	1.06
3C*	20.00	.501	15.59	-3.692	4.19	-1.54	.561	5.94	.26	1.07	1.06
4C	20.40	.525	18.88	-8.167	1.35	-.12	.768	8.70	.78	1.07	1.06
5C	20.40	.525	18.70	-7.309	1.56	-.56	.759	8.60	.78	1.07	1.06
1S	20.00	.524	18.36	-7.379	1.54	-.63	.763	8.45	.78	1.07	1.06
2S	20.20	.525	18.67	-7.977	1.40	-.34	.771	8.64	.78	1.07	1.06
3S	20.50	.526	18.96	-8.052	1.38	-.20	.768	8.76	.91	1.07	1.06
1T	20.40	.526	18.74	-7.576	1.51	-.41	.761	8.63	.91	1.07	1.06
2T	20.50	.525	18.95	-8.040	1.38	-.20	.768	8.74	.78	1.07	1.06
3T	20.20	.524	18.63	-7.804	1.43	-.32	.765	8.57	.78	1.07	1.06
4T	20.20	.523	18.54	-7.425	1.52	-.52	.761	8.50	.78	1.07	1.06

AVERAGES: 61020 BASELINE W020 00 000

	23.40	.561	21.81	-8.775	1.32	.00	.779	10.82	5.15	7.30	6.99
STD	.17	.001	.13	.527	.10	.18	.006	.08	.19	*	*

61020 W050TI-V001 (2E11-4E11)

	20.34	.525	18.72	-7.661	1.48	.41	.764	8.62	.80	1.07	1.06
STD	.17	.001	.17	.368	.09	.19	.005	.09	.05	*	*

PERCENT OF BASELINE

	86.9	93.6	85.8	112.7	112	*****	98.1	79.7	15.6	14.7	15.2
STDZ	1.3	.4	1.3	9.7	16	*****	1.3	1.4	1.6	.0	.0



TABLE 16 SOLAR CELL I-V DATA (Cont.)

60908 W051CU/TI001 (1.7E15-2E14) W002 00 000  
 \*SOL3 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.553	20.30	-6.469	1.92	-.57	.732	9.63	.00	.00	.00
1B	22.90	.560	21.35	-8.842	1.30	.09	.778	10.55	4.29	8.57	6.34
2B	22.60	.557	20.53	-6.648	1.86	-.91	.750	9.99	3.90	8.57	6.34
3B	21.00	.552	19.58	-8.797	1.30	-.08	.782	9.58	1.95	8.57	6.34
4B	22.80	.558	20.97	-7.489	1.59	-.49	.764	10.28	4.16	8.57	6.34
1C	13.90	.467	12.75	-7.748	1.32	.04	.748	5.13	.10	1.57	.50
2C	13.70	.464	12.47	-7.260	1.44	-.16	.738	4.96	.10	1.57	.50
3C	13.80	.465	12.63	-7.573	1.36	-.17	.748	5.07	.10	1.57	.50
4C	14.00	.465	12.70	-6.983	1.51	-.55	.738	5.08	.10	1.57	.50
5C	13.90	.464	12.67	-7.305	1.42	-.22	.741	5.05	.10	1.57	.50
1S	13.80	.460	12.33	-6.164	1.79	-1.40	.725	4.87	.10	1.57	.50
2S	14.00	.466	12.84	-7.778	1.31	.06	.748	5.16	.10	1.57	.50
1T	13.70	.464	12.50	-7.309	1.42	-.47	.747	5.02	.10	1.57	.50
2T	13.70	.464	12.32	-6.352	1.73	-1.65	.739	4.97	.10	1.57	.50
3T	13.70	.464	12.45	-6.991	1.51	-.84	.745	5.01	.10	1.57	.50
4T*	13.30	.523	10.98	-4.134	3.87	-5.89	.651	4.79	1.95	1.57	.50

AVERAGES: 60908 BASELINE W002 00 000

	22.33	.557	20.61	-7.944	1.51	-.34	.768	10.10	3.58	8.57	6.34
STD	.77	.003	.66	.925	.23	.39	.012	.36	.95	*	*

60908 W051CU/TI001 (1.7E15-2E14)

	13.82	.464	12.57	-7.146	1.48	-.53	.742	5.03	.10	1.57	.50
STD	.12	.002	.17	.515	.15	.56	.007	.08	.00	*	*

PERCENT OF BASELINE

	61.9	83.4	61.0	110.0	98	44.9	96.5	49.8	2.8	18.3	7.9
STD%	2.7	.8	2.8	17.7	27	520.8	2.4	2.6	.7	.0	.0

61213 W055CU004 (5E13) W020 00 000

\*SOL3 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.553	20.24	-6.410	1.94	-.36	.723	9.51	.00	.00	.00
1B	22.90	.555	20.92	-7.065	1.71	-.55	.754	10.13	4.29	7.30	7.00
3B	22.90	.557	21.17	-7.903	1.49	-.34	.771	10.40	5.20	7.30	7.00
5B	22.70	.556	20.57	-6.519	1.90	-.97	.748	9.98	3.90	7.30	7.00
1C	22.70	.552	20.62	-6.634	1.85	-.93	.751	9.95	3.90	.00	.00
2C	23.20	.553	20.96	-6.352	1.96	-1.00	.743	10.08	4.55	.00	.00
3C	23.20	.553	21.14	-6.828	1.78	-.81	.755	10.24	5.20	.00	.00
4C	23.20	.553	20.96	-6.352	1.96	-1.00	.743	10.08	2.86	.00	.00
5C	22.70	.551	20.80	-7.180	1.66	-.72	.763	10.09	4.16	.00	.00
2S	22.80	.552	20.97	-7.479	1.58	-.54	.766	10.19	4.42	.00	.00
3S	23.20	.554	21.35	-7.549	1.56	-.42	.764	10.39	4.94	.00	.00
1T	23.00	.555	21.12	-7.361	1.62	-.57	.763	10.31	4.81	.00	.00
2T	22.90	.553	20.94	-7.070	1.70	-.67	.758	10.15	4.55	.00	.00
3T	23.20	.554	21.30	-7.331	1.62	-.60	.764	10.38	5.20	.00	.00
4T	23.40	.551	21.17	-6.457	1.91	-.85	.743	10.13	3.90	.00	.00

AVERAGES: 61213 BASELINE W020 00 000

	22.83	.556	20.89	-7.162	1.70	-.62	.757	10.17	4.46	7.30	7.00
STD	.09	.001	.24	.569	.17	.26	.010	.17	.54	*	*

61213 W055CU004 (5E13)

	23.05	.553	21.03	-6.963	1.75	-.74	.756	10.18	4.41	.00	.00
STD	.23	.001	.20	.436	.14	.19	.009	.13	.65	*	*

PERCENT OF BASELINE

	100.9	99.4	100.7	102.8	103	81.6	99.8	100.1	98.8	.0	.0
STD%	1.4	.4	2.2	14.3	20	92.6	2.5	3.0	28.5	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70201 W056CU005 (6.5E16) BEFORE SINTER W020 00 000  
 \*SOL3 1 / 7 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.557	20.50	-7.241	1.66	.23	.732	9.70	.00	.00	.00
1B	22.70	.553	20.80	-7.373	1.61	-.22	.752	9.98	3.90	7.30	7.00
2B	22.90	.553	20.93	-7.248	1.65	-.17	.746	9.99	3.90	7.30	7.00
3B.*	23.10	.552	20.28	-5.258	2.55	-1.56	.707	9.53	3.25	7.30	7.00
1C	22.40	.543	20.00	-5.938	2.12	-.93	.721	9.28	3.25	4.85	6.66
2C	22.40	.546	19.98	-5.923	2.13	-.90	.720	9.31	3.25	4.85	6.66
3C	22.70	.546	20.36	-6.129	2.03	-.81	.727	9.53	3.25	4.85	6.66
4C	22.50	.543	20.00	-5.803	2.18	-.89	.714	9.22	2.86	4.85	6.66
5C	22.60	.546	20.37	-6.502	1.88	-.35	.726	9.48	3.51	4.85	6.66
1S	22.50	.544	20.23	-6.349	1.93	-.48	.725	9.38	3.12	4.85	6.66
2S	22.50	.547	20.33	-6.524	1.87	-.57	.734	9.56	3.51	4.85	6.66
3S	22.40	.545	20.25	-6.519	1.87	-.66	.737	9.52	3.25	4.85	6.66
1T	22.40	.546	20.34	-6.824	1.76	-.38	.739	9.56	3.25	4.85	6.66
2T.*	23.30	.538	19.26	-3.926	3.91	-3.27	.649	8.61	1.95	4.85	6.66
3T	22.20	.541	19.98	-6.343	1.93	-.63	.729	9.26	3.25	4.85	6.66
4T	22.30	.547	19.76	-5.907	2.15	-.22	.697	8.99	.38	4.85	6.66

AVERAGES: 70201 BASELINE W020 00 000

	22.80	.553	20.86	-7.310	1.63	-.20	.749	9.99	3.90	7.30	7.00
STD	.10	.000	.07	.062	.02	.02	.003	.01	.00	*	*

70201 W056CU005 (6.5E16) BEFORE SINTER

	22.45	.545	20.15	-6.251	1.99	-.62	.724	9.37	3.26	4.85	6.66
STD	.13	.002	.20	.316	.13	.23	.011	.17	.17	*	*

PERCENT OF BASELINE

	98.4	98.5	96.6	114.5	122	*****	96.7	93.8	83.6	66.4	95.1
STD%	1.0	.3	1.3	5.1	10	172.0	1.9	1.8	4.4	.0	.1

70201A W056CU005 (6.5E16) AFTER SINTER W020 00 000  
 \*SOL3 1 / 7 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.558	20.32	-6.657	1.86	-.14	.725	9.63	.00	.00	.00
2B	22.40	.558	20.24	-6.350	1.98	-1.14	.746	9.86	4.29	7.30	7.00
3B.*	22.50	.556	20.06	-5.707	2.29	-1.62	.732	9.68	3.25	7.30	7.00
1C	22.20	.549	20.24	-6.897	1.75	-.75	.754	9.71	3.51	4.85	6.66
2C	22.50	.553	20.52	-6.990	1.73	-.56	.751	9.88	3.51	4.85	6.66
3C.*	22.70	.544	18.10	-3.290	5.45	-6.75	.643	8.39	1.95	4.85	6.66
4C	22.60	.550	20.50	-6.685	1.82	-.64	.743	9.77	3.51	4.85	6.66
5C	22.60	.551	20.75	-7.433	1.59	-.40	.760	10.00	3.90	4.85	6.66
1S	22.40	.547	19.86	-5.551	2.34	-1.56	.722	9.36	2.99	4.85	6.66
2S	22.50	.548	20.47	-6.804	1.78	-.71	.750	9.78	3.51	4.85	6.66
3S	22.30	.547	20.29	-6.801	1.77	-.77	.751	9.69	3.90	4.85	6.66
1T	22.30	.549	20.44	-7.257	1.64	-.57	.760	9.83	3.90	4.85	6.66
2T.*	22.40	.537	17.51	-3.134	5.99	-7.36	.624	7.94	1.69	4.85	6.66
3T	22.20	.544	19.81	-5.759	2.21	-1.52	.731	9.34	3.25	4.85	6.66
4T	22.60	.547	19.08	-4.365	3.36	-2.34	.663	8.66	2.60	4.85	6.66

AVERAGES: 70201A BASELINE W020 00 000

	22.40	.558	20.24	-6.350	1.98	-1.14	.746	9.86	4.29	7.30	7.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*

70201A W056CU005 (6.5E16) AFTER SINTER

	22.42	.549	20.20	-6.454	2.00	-.98	.730	9.60	3.46	4.85	6.66
STD	.15	.002	.46	.897	.51	.59	.028	.37	.0	*	*

PERCENT OF BASELINE

	100.1	98.3	99.8	98.4	101	113.8	99.0	97.4	80.6	66.4	95.1
STD%	.7	.4	2.3	14.1	26	51.6	3.7	3.8	9.3	.0	.1

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70211A W061CR-TI001 (1E15-1.1E13) AFTER SINTER W020 00 000  
 \*SOL3 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	PF	Eff	OCD	PCDa	PCDb
1R*	22.50	.559	20.41	-6.908	1.78	-.05	.731	9.72	.00	.00	.00
1B	22.70	.560	20.75	-7.153	1.70	-.45	.752	10.12	4.29	7.30	7.00
2B	23.00	.560	21.10	-7.528	1.59	-.04	.750	10.22	4.29	7.30	7.00
3B	23.10	.562	21.28	-7.710	1.55	-.21	.761	10.45	5.20	7.30	7.00
4B	22.90	.562	21.28	-8.530	1.36	.09	.771	10.49	4.55	7.30	7.00
5B	22.90	.559	20.95	-7.256	1.66	-.27	.750	10.15	3.90	7.30	7.00
1C	17.30	.501	15.47	-6.241	1.87	-.57	.715	6.55	.13	.00	.00
2C	17.10	.500	15.54	-7.195	1.54	.18	.730	6.60	.13	.00	.00
3C	17.20	.497	15.36	-6.323	1.82	-.16	.707	6.39	.13	.00	.00
4C.*	17.20	.497	14.29	-4.116	3.50	-4.02	.655	5.87	.13	.00	.00
5C.*	17.40	.492	14.25	-3.953	3.74	-4.01	.637	5.77	.13	.00	.00
1S	14.80	.498	13.30	-6.697	1.71	.10	.713	5.56	.13	.00	.00
2S	17.50	.503	15.63	-6.159	1.91	-.70	.716	6.66	.13	.00	.00
3S	17.50	.502	15.75	-6.574	1.74	-.32	.722	6.71	.13	.00	.00
1T	15.90	.491	14.29	-6.654	1.69	-.01	.715	5.90	.13	.00	.00
2T	16.90	.496	15.33	-7.007	1.58	-.10	.731	6.48	.13	.00	.00
3T	16.80	.495	15.18	-6.805	1.64	-.13	.725	6.37	.13	.00	.00
4T	16.70	.495	14.97	-6.450	1.77	-.25	.714	6.24	.13	.00	.00
AVERAGES: 70211A BASELINE W020 00 000											
	22.92	.561	21.07	-7.635	1.57	-.18	.757	10.29	4.45	7.30	7.00
STD	.13	.001	.20	.489	.12	.18	.008	.16	.43	*	*
70211A W061CR-TI001 (1E15-1.1E13) AFTER SINTER											
	16.77	.498	15.08	-6.611	1.73	-.20	.719	6.35	.13	.00	.00
STD	.79	.004	.71	.316	.11	.26	.007	.35	.00	*	*
PERCENT OF BASELINE											
	73.2	88.8	71.6	113.4	110	88.1	95.0	61.7	2.9	.0	.0
STD%	3.9	.8	4.1	9.9	16	425.7	2.0	4.	.3	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70211 W061 CR-TI 001 (1E15-1.1E13) BEFORE SINTER W020 00 000  
 \*SOL3 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	EFF	OCD	PCDa	PCDb
1R*	22.50	.557	20.40	-6.889	1.78	-.05	.730	9.68	.00	.00	.00
1B	22.80	.557	20.82	-7.268	1.65	-.01	.741	9.95	4.55	7.30	7.00
2B	23.10	.558	21.06	-7.192	1.68	.02	.738	10.06	4.42	7.30	7.00
3B	23.10	.552	20.82	-6.595	1.86	-.04	.720	9.71	3.90	7.30	7.00
4B	23.20	.554	20.77	-6.125	2.06	-.58	.719	9.78	4.16	7.30	7.00
5B.*	23.70	.551	20.43	-4.866	2.84	-1.40	.678	9.36	3.25	7.30	7.00
1C	17.10	.498	15.33	-6.579	1.73	.23	.707	6.36	.13	.00	.00
2C	17.10	.495	15.22	-6.315	1.82	.27	.695	6.22	.13	.00	.00
3C	17.30	.495	15.34	-6.119	1.90	.08	.692	6.27	.13	.00	.00
4C	17.30	.495	15.42	-6.380	1.79	.34	.696	6.30	.13	.00	.00
5C	17.30	.497	15.43	-6.474	1.76	.59	.693	6.30	.13	.00	.00
1S	16.10	.497	13.55	-4.607	2.95	-1.94	.647	5.47	.13	.00	.00
2S	18.20	.501	15.78	-5.148	2.46	-1.39	.682	6.58	.13	.00	.00
3S	17.60	.500	15.14	-4.903	2.65	-2.00	.679	6.32	.13	.00	.00
1T	15.70	.491	13.87	-6.161	1.88	.56	.680	5.54	.13	.00	.00
2T	17.30	.496	15.42	-6.210	1.86	-.27	.706	6.40	.13	.00	.00
3T	17.30	.496	15.39	-6.263	1.84	.13	.697	6.32	.13	.00	.00
4T	17.10	.493	15.26	-6.295	1.82	-.17	.706	6.30	.13	.00	.00
AVERAGES: 70211 BASELINE W020 00 000											
	23.05	.555	20.87	-6.795	1.81	-.15	.730	9.88	4.26	7.30	7.00
STD	.15	.002	.11	.466	.16	.25	.010	.14	.25	*	*
70211 W061 CR-TI 001 (1E15-1.1E13) BEFORE SINTER											
	17.12	.496	15.10	-5.955	2.04	-.30	.690	6.20	.13	.00	.00
STD	.62	.003	.64	.638	.39	.90	.016	.32	.00	*	*
PERCENT OF BASELINE											
	74.3	89.4	72.3	112.4	112	6.8	94.5	62.8	3.1	.0	.0
STDZ	3.2	.9	3.5	16.1	34	*****	3.5	4.2	.2	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

702112 W061CR-T1001 (1E15-2E13) 1ST RETEST 3-29-77 W020 00 000  
 \*SOL3 1 / 7 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.556	20.28	-6.553	1.89	-.21	.723	9.57	.00	.00	.00
1B	22.60	.558	20.66	-7.173	1.69	-.39	.751	10.01	4.29	7.30	7.00
2B	22.90	.558	20.71	-6.623	1.87	-.38	.732	9.90	3.64	7.30	7.00
3B	22.90	.558	21.04	-7.490	1.59	-.34	.759	10.26	4.55	7.30	7.00
4B	22.80	.556	20.84	-7.183	1.68	-.32	.749	10.04	3.90	7.30	7.00
5B	22.60	.559	20.60	-7.009	1.74	-.42	.747	9.98	3.90	7.30	7.00
1C	17.10	.499	15.45	-6.871	1.63	.03	.723	6.52	.13	.00	.00
2C	17.20	.497	15.54	-6.873	1.63	.09	.721	6.52	.13	.00	.00
3C	17.00	.491	15.07	-6.015	1.93	-.33	.698	6.16	.13	.00	.00
4C	16.90	.490	14.35	-4.631	2.86	-2.42	.665	5.83	.13	.00	.00
5C	17.20	.490	14.38	-4.328	3.19	-2.91	.651	5.81	.13	.00	.00
1S	14.60	.496	13.04	-6.323	1.85	-.44	.710	5.44	.13	.00	.00
2S	17.40	.501	15.67	-6.585	1.73	-.35	.723	6.67	.13	.00	.00
3S	17.40	.500	15.64	-6.555	1.74	-.19	.718	6.60	.13	.00	.00
1T	16.50	.494	14.69	-6.116	1.90	-.57	.708	6.10	.13	.00	.00
2T	16.60	.494	14.92	-6.579	1.72	-.21	.718	6.23	.13	.00	.00
3T	16.70	.494	15.06	-6.670	1.69	-.35	.726	6.33	.13	.00	.00
4T	15.90	.488	14.02	-5.796	2.04	-.68	.695	5.70	.13	.00	.00

AVERAGES: 702112 BASELINE W020 00 000

	22.76	.558	20.77	-7.096	1.71	-.37	.748	10.04	4.06	7.30	7.00
STD	.13	.001	.16	.283	.09	.04	.009	.12	.32	*	*

702112 W061CR-T1001 (1E15-2E13) 1ST RETEST 3-29-77

	16.71	.495	14.82	-6.112	1.99	-.70	.705	6.16	.13	.00	.00
STD	.76	.004	.75	.798	.48	.91	.023	.38	.00	*	*

PERCENT OF BASELINE

	73.4	88.7	71.4	113.9	116	11.8	94.3	61.4	3.2	.0	.0
STDZ	3.8	.9	4.2	15.1	36	290.7	4.2	4.6	.3	.0	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70502 W062N-CU001 (2.5E15) N BASE W060 00 000

\*SOL1 1 / 7 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.556	20.28	-6.553	1.89	-.21	.723	9.57	.00	.00	.00
1B	22.30	.562	20.61	-8.154	1.44	.21	.758	10.05	.26	.00	.00
2B	22.00	.559	19.84	-6.398	1.97	-.78	.735	9.56	4.03	.00	.00
3B.*	22.70	.565	20.23	-5.857	2.24	-1.00	.719	9.76	3.25	.00	.00
4B	22.30	.560	20.11	-6.393	1.97	-.75	.734	9.70	5.20	.00	.00
5B	22.20	.562	20.44	-7.739	1.54	-.14	.759	10.01	5.85	.00	.00
1C	22.60	.565	20.88	-8.020	1.48	.00	.762	10.29	7.80	.00	.00
2C.*	15.60	.560	13.20	-4.403	3.60	-4.99	.681	6.29	7.15	.00	.00
3C	22.50	.561	20.91	-8.533	1.36	.01	.774	10.33	10.40	.00	.00
4C	22.60	.558	19.64	-5.272	2.57	-.52	.673	8.98	6.50	.00	.00
5C	22.60	.569	21.11	-9.141	1.27	.27	.777	10.57	1.30	.00	.00
6C	21.60	.560	19.75	-7.196	1.69	-.41	.751	9.61	6.50	.00	.00
7C	22.40	.554	19.37	-4.895	2.85	-1.74	.686	9.00	3.64	.00	.00
8C	21.70	.547	18.90	-5.135	2.63	-1.43	.691	8.67	5.85	.00	.00
1S	21.90	.550	19.71	-6.292	1.98	-.84	.733	9.33	.39	.00	.00
2S	22.00	.555	20.03	-6.901	1.77	-.58	.747	9.65	5.20	.00	.00
3S	22.60	.560	21.09	-9.022	1.27	.27	.775	10.37	10.40	.00	.00
4S	22.30	.555	20.49	-7.602	1.56	-.15	.755	9.89	.50	.00	.00
5S	22.30	.555	20.20	-6.591	1.88	-.70	.741	9.70		.00	.00
1T	22.10	.572	20.46	-8.267	1.45	.16	.762	10.19		.00	.00
2T	22.70	.568	21.05	-8.360	1.41	.09	.767	10.46	9.10	.00	.00
3T	22.70	.568	20.95	-7.946	1.51	-.02	.761	10.37	5.20	.00	.00
4T	22.00	.567	20.21	-7.529	1.61	-.27	.757	9.99	8.19	.00	.00
5T	22.50	.568	20.70	-7.636	1.58	-.22	.759	10.25	6.50	.00	.00

AVERAGES: 70502 BASELINE W060 00 000

22.20 .561 20.25 -7.171 1.73 -.37 .747 9.83 3.84 .00 .00

STD .12 .001 .30 .789 .24 .42 .012 .21 2.16 \* \*

70502 W062N-CU001 (2.5E15) N BASE

22.30 .561 20.32 -7.314 1.76 -.36 .745 9.86 6.39 .00 .00

STD .34 .007 .65 1.270 .47 .55 .031 .56 2.71 \* \*

PERCENT OF BASELINE

100.5 100.0 100.3 98.0 101 102.6 99.8 100.3 166.7 \*\*\*\*\* \*\*\*\*\*

STD% 2.1 1.5 4.7 30.9 45 432.0 5.8 8.0 204.6 \*\*\*\*\* \*\*\*\*\*

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70518 W063N-CR001 (8E14) W060 00 000  
 \*SOL1 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.552	20.27	-6.517	1.89	-.21	.722	9.48	.00	.00	.00
1B	22.10	.555	20.13	-7.211	1.67	.18	.733	9.50	1.04	.00	.00
2B	22.00	.562	20.44	-8.750	1.32	.51	.761	9.96	8.71	.00	.00
3B	21.30	.559	19.64	-7.976	1.48	.13	.756	9.52	7.80	.00	.00
4B	21.50	.560	19.63	-7.187	1.69	-.25	.746	9.49	6.50	.00	.00
5B*	21.40	.551	19.18	-6.219	2.02	-.62	.722	9.00	5.20	.00	.00
1C	18.40	.523	16.12	-5.929	2.08	.83	.664	6.76	1.30	.00	.00
2C	18.50	.522	17.09	-8.465	1.30	.81	.746	7.62	1.69	.00	.00
3C	18.40	.522	16.98	-8.268	1.33	.52	.750	7.62	1.56	.00	.00
4C	18.30	.524	16.96	-8.643	1.27	.65	.755	7.66	1.69	.00	.00
5C.*	18.50	.527	15.06	-3.966	3.94	-3.09	.620	6.39	1.17	.00	.00
6C	19.00	.526	17.59	-8.678	1.26	.91	.747	7.90	1.69	.00	.00
7C	18.60	.524	16.66	-6.229	1.95	-.76	.722	7.44	1.56	.00	.00
8C	18.40	.521	16.21	-5.859	2.11	-.03	.684	6.94	1.30	.00	.00
9C	18.70	.525	17.28	-8.405	1.31	.58	.751	7.80	1.30	.00	.00
1S.*	18.80	.516	14.50	-3.268	5.54	-6.29	.590	6.05	1.04	.00	.00
2S	18.90	.521	17.30	-7.578	1.49	.25	.740	7.71	1.30	.00	.00
3S	19.10	.522	17.66	-8.534	1.28	.77	.748	7.89	1.69	.00	.00
4S.*	19.10	.523	14.89	-3.506	4.87	-3.88	.580	6.13	1.30	.00	.00
5S	19.10	.522	17.49	-7.637	1.47	.34	.739	7.79	1.69	.00	.00
1T	18.70	.524	17.22	-8.024	1.39	.33	.750	7.77	1.69	.00	.00
2T	18.60	.526	17.10	-7.786	1.45	.08	.751	7.77	1.56	.00	.00
3T	18.80	.524	17.22	-7.573	1.50	.12	.744	7.75	1.30	.00	.00
4T	18.80	.524	17.14	-7.345	1.56	.22	.734	7.65	1.30	.00	.00
5T	19.10	.523	17.61	-8.120	1.36	.34	.752	7.94	1.30	.00	.00
6T	18.80	.522	17.18	-7.423	1.53	.04	.742	7.70	1.56	.00	.00
AVERAGES: 70518 BASELINE W060 00 000											
	21.73	.559	19.96	-7.781	1.54	.14	.749	9.62	6.01	.00	.00
STD	.33	.003	.34	.643	.15	.27	.011	.20	2.98	*	*
70518 W063N-CR001 (8E14)											
	18.72	.523	17.11	-7.676	1.51	.35	.736	7.63	1.50	.00	.00
STD	.26	.002	.42	.880	.27	.40	.024	.31	.17	*	*
PERCENT OF BASELINE											
	86.2	93.6	85.7	101.3	98	250.4	98.3	79.3	24.9	*****	*****
STD%	2.	.7	3.6	20.4	29	*****	4.7	4.9	16.7	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70519 W064N-MN001 (1E15) W060 00 000  
 \*SOL2 1 / 7 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.22	-6.379	1.96	-.33	.721	9.52	.00	.00	.00
1B	22.60	.568	20.82	-7.770	1.55	-.13	.759	10.31	1.43	.00	.00
2B	22.10	.553	19.81	-6.125	2.07	-.87	.727	9.39	5.85	.00	.00
3B	22.30	.553	20.44	-7.627	1.55	.27	.742	9.67	7.54	.00	.00
4B	22.20	.556	20.06	-6.637	1.86	-.30	.729	9.52	5.20	.00	.00
5B*	21.90	.553	19.35	-5.480	2.42	-1.51	.714	9.15	4.81	.00	.00
1C	21.40	.547	19.40	-6.840	1.77	-.23	.733	9.08	5.20	.00	.00
2C	21.90	.559	20.43	-9.041	1.27	.33	.773	10.01	6.76	.00	.00
3C	21.30	.546	19.73	-8.591	1.32	.66	.753	9.26	5.20	.00	.00
4C	21.00	.541	19.28	-7.926	1.45	.68	.736	8.85	3.25	.00	.00
5C*	17.80	.524	15.33	-5.053	2.65	-1.28	.670	6.61	1.95	.00	.00
6C	21.70	.547	20.16	-8.871	1.27	.70	.757	9.50	6.50	.00	.00
7C	21.50	.550	19.92	-8.387	1.37	.22	.763	9.54	5.20	.00	.00
8C	21.20	.547	19.71	-8.855	1.27	.55	.762	9.34	4.55	.00	.00
9C	21.20	.543	19.39	-7.394	1.59	-.02	.744	9.06	3.90	.00	.00
10C	22.00	.545	19.98	-6.521	1.87	-1.34	.759	9.62	5.20	.00	.00
1S	21.20	.544	19.01	-6.259	1.98	-.55	.721	8.79	3.90	.00	.00
2S	21.80	.546	19.58	-6.368	1.94	-.33	.720	9.06	4.16	.00	.00
3S	21.60	.545	19.90	-8.110	1.41	.57	.744	9.27	5.85	.00	.00
4S	21.90	.555	20.33	-8.566	1.34	.28	.765	9.83	6.50	.00	.00
5S	21.40	.549	19.83	-8.413	1.36	.28	.761	9.46	5.46	.00	.00
6S	21.70	.544	19.95	-7.870	1.46	.35	.745	9.31	4.94	.00	.00
1T	20.80	.549	19.11	-7.660	1.53	-.10	.754	9.11	4.29	.00	.00
2T	21.00	.545	19.20	-7.322	1.61	-.13	.746	9.03	3.90	.00	.00
3T	21.60	.556	19.97	-8.176	1.43	.12	.761	9.67	5.20	.00	.00
4T	21.00	.536	18.45	-5.458	2.37	-1.07	.698	8.31	2.34	.00	.00
5T	21.00	.541	18.98	-6.642	1.82	-.35	.730	8.77	2.99	.00	.00
6T	21.60	.553	19.79	7.375	1.62	-.32	.754	9.53	3.90	.00	.00
AVERAGES: 70519 BASELINE W060 00 000											
	22.30	.558	20.28	-7.040	1.76	-.26	.739	9.72	5.01	.00	.00
STD	.19	.006	.38	.685	.22	.41	.013	.35	2.23	*	*
70519 W064N-MN001 (1E15)											
	21.42	.547	19.62	-7.650	1.57	.01	.747	9.26	4.72	.00	.00
STD	.34	.005	.48	.974	.28	.54	.018	.39	1.15	*	*
PERCENT OF BASELINE											
	96.0	98.1	96.7	91.3	90	205.6	101.0	95.2	94.4	*****	*****
STD%	2.4	2.0	4.2	25.8	29	558.3	4.2	7.6	75.2	*****	*****



TABLE 16 SOLAR CELL I-V DATA (Cont.)

70520 W065N-TI001 (2E14) W060 00 000  
 \*SOL2 1 / 7 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.34	-6.794	1.80	.10	.722	9.53	.00	.00	.00
1B	22.10	.565	20.41	-7.972	1.49	-.07	.763	10.07	9.75	.00	.00
2B	22.40	.569	20.86	-8.805	1.33	.25	.771	10.40	10.40	.00	.00
3B	22.40	.562	20.51	-7.385	1.64	-.14	.749	9.97	8.45	.00	.00
4B	21.90	.563	19.97	-7.068	1.74	-.35	.745	9.72	7.80	.00	.00
5B	22.60	.568	20.95	-8.672	1.35	.72	.753	10.22	9.10	.00	.00
1C	19.10	.531	17.53	-7.643	1.50	-.06	.752	8.06	1.69	.00	.00
2C	19.10	.525	17.37	-6.948	1.68	-.47	.742	7.87	1.56	.00	.00
3C	19.20	.529	17.52	-7.202	1.61	-.28	.745	8.00	1.04	.00	.00
4C	19.20	.529	17.57	-7.380	1.56	-.25	.750	8.05	1.56	.00	.00
5C	19.10	.526	17.18	-6.390	1.88	-.70	.728	7.73	1.30	.00	.00
6C	19.20	.524	17.33	-6.594	1.79	-.46	.729	7.76	1.30	.00	.00
7C	18.90	.534	17.22	-7.105	1.66	-.34	.743	7.93	1.30	.00	.00
8C	19.00	.529	17.30	-7.122	1.64	-.18	.739	7.86	1.30	.00	.00
9C	19.20	.532	17.61	-7.530	1.53	-.18	.752	8.12	1.30	.00	.00
1S	19.30	.531	17.68	-7.518	1.53	-.07	.748	8.11	1.56	.00	.00
2S	19.30	.528	17.59	-7.088	1.64	-.40	.745	8.03	1.30	.00	.00
3S	19.80	.534	18.23	-7.954	1.43	.22	.752	8.40	1.69	.00	.00
4S	19.10	.529	17.48	-7.394	1.56	-.20	.748	8.00	1.30	.00	.00
5S	19.30	.530	17.71	-7.584	1.51	-.10	.751	8.13	1.56	.00	.00
1T	19.10	.531	17.44	-7.327	1.58	-.02	.741	7.95	1.56	.00	.00
2T	19.00	.527	17.29	-7.102	1.64	-.18	.739	7.82	1.56	.00	.00
3T	18.90	.530	17.29	-7.471	1.54	.00	.744	7.89	1.30	.00	.00
4T	19.00	.527	17.11	-6.476	1.85	-.60	.728	7.71	1.30	.00	.00
5T	19.10	.528	17.33	-6.867	1.71	-.40	.737	7.86	1.30	.00	.00
6T	19.10	.528	17.40	-7.074	1.65	-.40	.744	7.94	1.30	.00	.00
AVERAGES: 70520 BASELINE W060 00 000											
	22.28	.565	20.54	-7.980	1.51	.08	.756	10.07	9.10	.00	.00
STD	.25	.003	.35	.685	.16	.37	.010	.23	.92	*	*
70520 W065N-TI001 (2E14)											
	19.15	.529	17.46	-7.188	1.62	-.25	.743	7.96	1.40	.00	.00
STD	.19	.003	.24	.391	.11	.22	.007	.16	.17	*	*
PERCENT OF BASELINE											
	86.0	93.6	85.0	109.9	108	*****	98.2	79.0	15.4	*****	*****
STD%	1.8	.9	2.6	13.0	20	*****	2.2	3.4	3.6	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70422 W066TI005 (3.3E13) W054 00 000

\*SOI.1 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.556	20.22	-6.388	1.96	-.33	.721	9.54	.00	.00	.00
1B	22.70	.558	21.05	-8.267	1.41	-.14	.773	10.35	5.20	.00	6.30
2B	22.70	.553	20.89	-7.610	1.55	-.30	.761	10.11	4.55	.00	6.30
3B	22.90	.554	20.99	-7.311	1.63	-.41	.756	10.15	4.55	.00	6.30
4B	22.50	.553	20.64	-7.336	1.62	-.49	.760	10.00	4.55	.00	6.30
5B	22.80	.558	21.07	-7.958	1.48	-.21	.768	10.33	5.20	.00	6.30
1C	16.50	.500	14.68	-6.210	1.89	-.16	.702	6.12	.26	.00	.00
2C	17.00	.501	15.09	-6.060	1.95	-.33	.700	6.31	.26	.00	.00
3C	16.60	.498	14.72	-6.075	1.94	-.24	.698	6.10	.26	.00	.00
4C	16.60	.498	14.72	-6.075	1.94	-.24	.698	6.10	.26	.00	.00
5C	16.40	.499	14.49	-5.984	1.99	-.12	.690	5.97	.26	.00	.00
6C	17.10	.500	15.10	-5.887	2.03	-.38	.693	6.27	.26	.00	.00
1S	17.30	.503	15.37	-6.123	1.93	-.22	.700	6.44	.26	.00	.00
2S	17.30	.503	15.37	-6.123	1.93	-.22	.700	6.44	.26	.00	.00
3S	16.60	.500	14.80	-6.292	1.85	-.11	.704	6.18	.26	.00	.00
4S	17.10	.502	15.17	-6.084	1.94	-.17	.697	6.33	.26	.00	.00
5S	17.50	.502	15.38	-5.671	2.14	-.63	.690	6.41	.26	.00	.00
1T	16.90	.497	14.92	-5.882	2.02	-.38	.693	6.15	.26	.00	.00
2T	16.60	.499	14.80	-6.314	1.84	.02	.701	6.14	.26	.00	.00
3T	16.50	.497	14.63	-6.044	1.95	-.32	.698	6.06	.26	.00	.00
4T	16.80	.498	14.89	-6.059	1.94	-.14	.695	6.15	.26	.00	.00
AVERAGES: 70422 BASELINE W054 00 000											
	22.72	.555	20.93	-7.696	1.54	-.31	.764	10.19	4.81	.00	6.30
STD	.13	.002	.16	.369	.09	.13	.006	.13	.32	*	*
70422 W066TI005 (3.3E13)											
	16.85	.500	14.94	-6.059	1.95	-.24	.697	6.21	.26	.00	.00
STD	.33	.002	.28	.157	.07	.15	.004	.14	.00	*	*
PERCENT OF BASELINE											
	74.2	90.0	71.4	121.3	127	122.1	91.3	61.0	5.4	*****	.0
STD%	1.9	.7	1.9	5.9	12	100.3	1.2	2.2	.4	*****	.0

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70425 W067CR-MN-TI001 (4E14-5E14-3.3E12) W054 00 000  
 \*SOL1 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.554	20.24	-6.452	1.93	-.27	.721	9.51	.00	.00	.00
1B	22.70	.553	20.96	-7.898	1.48	-.17	.765	10.15	4.94	.00	.00
2B*	22.70	.548	20.06	-5.591	2.32	-1.01	.707	9.30	3.64	.00	.00
3B	22.70	.549	20.69	-7.113	1.68	-.14	.741	9.76	5.20	.00	.00
4B	22.90	.556	21.18	-8.092	1.44	-.06	.766	10.31	5.85	.00	.00
1C	18.70	.519	16.77	-6.267	1.91	-.79	.725	7.44	.39	.00	.00
2C	19.10	.519	17.13	-6.431	1.84	-.14	.713	7.48	.52	.00	.00
3C	19.70	.529	17.69	-6.464	1.86	-.18	.716	7.90	.78	.00	.00
4C	19.80	.529	17.74	-6.331	1.91	-.34	.716	7.93	.78	.00	.00
5C	19.60	.518	16.61	-4.633	2.96	-1.59	.654	7.02	.52	.00	.00
6C	19.20	.518	17.28	-6.554	1.79	-.22	.721	7.58	.39	.00	.00
7C	19.00	.514	16.59	-5.436	2.31	-.72	.683	7.05	.39	.00	.00
1S	19.30	.529	17.33	-6.252	1.95	-.92	.729	7.87	.78	.00	.00
2S	19.60	.526	17.45	-6.165	1.97	-.08	.701	7.64	.78	.00	.00
3S	19.60	.526	17.50	-6.067	2.02	-.80	.718	7.63	.78	.00	.00
4S	19.30	.525	17.37	-6.546	1.82	-.24	.721	7.72	.78	.00	.00
5S	19.70	.529	17.53	-5.907	2.10	-.94	.715	7.88	1.04	.00	.00
1T	18.60	.516	16.27	-5.382	2.36	-1.21	.692	7.02	.52	.00	.00
2T	19.00	.515	16.73	-5.636	2.20	-.85	.697	7.21	.39	.00	.00
3T	18.90	.511	16.57	-5.598	2.20	-.52	.686	7.00	.26	.00	.00
4T	18.60	.513	16.58	-6.076	1.97	-.67	.713	7.19	.39	.00	.00
5T	18.90	.514	16.91	-6.247	1.90	-.51	.716	7.36	.39	.00	.00
AVERAGES: 70425 BASELINE W054 00 000											
	22.77	.553	20.94	-7.701	1.53	-.12	.757	10.07	5.33	.00	.00
STD	.10	.003	.20	.423	.10	.05	.011	.23	.38	*	*
70425 W067CR-MN-TI001 (4E14-5E14-3.3E12)											
	19.21	.521	17.06	-5.999	2.06	-.63	.707	7.48	.58	.00	.00
STD	.39	.006	.45	.498	.28	.40	.019	.33	.21	*	*
PERCENT OF BASELINE											
	84.4	94.2	81.5	122.1	135	*****	93.4	74.2	10.9	*****	*****
STD%	2.1	1.6	2.9	11.1	29	662.9	3.9	5.1	5.1	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70426 W068CR004 (1E15) W054 00 000

\*SOL1 1 /7 /80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.556	20.22	-6.388	1.96	-.33	.721	9.54	.00	.00	.00
1B	22.30	.556	20.57	-7.730	1.53	-.42	.768	10.08	4.55	.00	.00
2B	22.90	.558	21.21	-8.150	1.43	-.17	.771	10.42	5.60	.00	.00
3B	22.40	.555	20.39	-6.781	1.81	-.87	.754	9.91	5.20	.00	.00
4B	23.10	.556	21.24	-7.520	1.58	-.40	.763	10.36	5.60	.00	.00
5B	22.50	.553	20.72	-7.551	1.56	-.58	.769	10.12	4.81	.00	.00
1C	19.30	.519	17.43	-6.563	1.79	-.65	.734	7.77	.65	.00	.00
2C	20.00	.519	17.89	-6.060	1.99	-.97	.724	7.95	.65	.00	.00
3C	20.10	.518	17.87	-5.790	2.11	-1.19	.718	7.91	.65	.00	.00
5C	19.70	.514	17.24	-5.354	2.35	-1.20	.694	7.43	.52	.00	.00
6C	19.10	.515	16.88	-5.638	2.19	-1.21	.708	7.37	.52	.00	.00
7C	19.90	.520	17.88	-6.241	1.91	-.92	.730	7.99	.65	.00	.00
8C	20.20	.519	17.95	-5.770	2.13	-1.18	.717	7.95	.65	.00	.00
9C	20.60	.524	18.55	-6.312	1.89	-.94	.735	8.39	.78	.00	.00
1S	20.40	.524	18.36	-6.319	1.89	-.85	.732	8.28	.91	.00	.00
2S	20.20	.524	18.15	-6.241	1.93	-.91	.731	8.18	.78	.00	.00
3S	20.20	.524	18.12	-6.223	1.93	-.78	.726	8.12	.78	.00	.00
4S	20.30	.524	18.11	-5.990	2.04	-.88	.719	8.08	.78	.00	.00
5S	20.90	.527	18.90	-6.621	1.78	-.55	.736	8.57	.91	.00	.00
1T	19.60	.520	17.64	-6.414	1.85	-.66	.729	7.86	.78	.00	.00
2T	19.60	.517	17.47	-5.943	2.04	-1.01	.719	7.70	.52	.00	.00
3T	19.80	.517	17.75	-6.244	1.90	-.63	.721	7.81	.52	.00	.00
4T	20.00	.519	17.32	-5.247	2.44	-.57	.669	7.35	.52	.00	.00
5T	19.60	.517	17.51	-6.069	1.98	-.88	.721	7.73	.65	.00	.00
AVERAGES: 70426 BASELINE W054 00 000											
	22.64	.556	20.83	-7.546	1.58	-.49	.765	10.18	5.15	.00	.00
STD	.31	.002	.34	.444	.12	.23	.006	.19	.42	*	*
70426 W068CR004 (1E15)											
	19.97	.520	17.83	-6.058	2.01	-.89	.720	7.91	.68	.00	.00
STD	.44	.004	.48	.370	.18	.21	.016	.33	.13	*	*
PERCENT OF BASELINE											
	88.2	93.6	85.6	119.7	127	18.6	94.1	77.8	13.2	*****	*****
STD%	3.2	.9	3.8	9.9	22	148.8	2.9	4.7	3.7	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70512 W069FE004 (1E15) W054 00 000

\*SOL1 1 /7 /80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.553	20.21	-6.362	1.96	-.33	.720	9.47	.00	.00	.00
1B.*	22.30	.550	19.87	-5.735	2.25	-1.49	.729	9.45	3.25	.00	.00
2B	22.50	.552	20.60	-7.213	1.66	-.56	.758	9.96	3.25	.00	.00
3B	22.50	.552	20.43	-6.621	1.85	-.93	.750	9.85	3.90	.00	.00
4B*	22.10	.550	19.78	-5.953	2.14	-1.27	.732	9.41	3.12	.00	.00
5B	22.80	.550	20.45	-6.020	2.10	-1.17	.734	9.73	3.64	.00	.00
1C	20.30	.564	17.71	-5.160	2.72	-1.80	.697	8.44	.91	.00	.00
2C	20.90	.571	19.08	-7.067	1.77	-.65	.753	9.51	1.17	.00	.00
3C	20.30	.570	18.59	-7.284	1.70	-.55	.756	9.25	1.30	.00	.00
4C	19.00	.563	17.30	-6.882	1.82	-.92	.751	8.50	.65	.00	.00
5C	20.30	.567	17.72	-5.076	2.80	-2.36	.706	8.60	.91	.00	.00
6C	18.90	.562	17.26	-7.111	1.74	-.77	.755	8.48	.91	.00	.00
7C	20.50	.572	18.60	-6.651	1.93	-1.04	.749	9.29	1.04	.00	.00
8C	20.30	.575	18.52	-6.956	1.82	-.89	.755	9.32	1.30	.00	.00
9C	20.30	.568	17.91	-5.491	2.50	-1.64	.712	8.68	1.30	.00	.00
10C	20.20	.570	18.07	-5.874	2.28	-1.85	.738	8.99	1.30	.00	.00
11C	20.80	.573	18.60	-5.946	2.24	-1.37	.730	9.20	1.30	.00	.00
1S	21.20	.575	18.79	-5.547	2.48	-1.83	.723	9.32	1.17	.00	.00
2S*	20.90	.500	15.67	-4.958	2.55	6.69	.455	5.03	.13	.00	.00
3S	21.40	.573	19.11	-5.855	2.29	-1.44	.729	9.45	1.30	.00	.00
4S	21.40	.571	18.68	-5.066	2.81	-2.18	.705	9.11	1.30	.00	.00
5S*	21.20	.455	15.44	-5.314	2.09	7.74	.424	4.32	.13	.00	.00
1T*	17.10	.551	15.68	-7.404	1.63	-.74	.760	7.58	.65	.00	.00
2T*	17.90	.400	13.25	-5.566	1.75	7.88	.433	3.28	.13	.00	.00
3T*	17.70	.317	13.06	-4.985	1.64	5.36	.442	2.62	.13	.00	.00
4T	18.30	.555	16.69	-7.116	1.72	-.54	.748	8.03	.52	.00	.00
5T*	16.70	.403	12.53	-5.654	1.74	8.17	.443	3.15	.13	.00	.00
6T	17.90	.552	16.42	-7.594	1.58	-.21	.753	7.87	.65	.00	.00
AVERAGES: 70512 BASELINE W054 00 000											
	22.60	.551	20.49	-6.618	1.87	-.88	.747	9.85	3.60	.00	.00
STD	.14	.001	.08	.487	.18	.25	.010	.09	.27	*	*
70512 W069FE004 (1E15)											
	20.13	.568	18.07	-6.292	2.14	-1.25	.735	8.88	1.06	.00	.00
STD	1.02	.007	.80	.848	.41	.62	.020	.50	.26	*	*
PERCENT OF BASELINE											
	89.0	102.9	88.2	104.9	114	58.4	98.4	90.2	29.	*****	*****
STDZ	5.1	1.4	4.3	20.7	35	131.2	4.1	5.9	10.1	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70516 W070AL003 (5E16) W054 00 000  
 \*SOL1 1 / 7 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.556	20.25	-6.469	1.93	-.27	.722	9.55	.00	.00	.00
1B*	18.60	.549	16.08	-4.746	3.04	-3.53	.705	7.61	2.99	.00	.00
2B	22.00	.551	19.86	-6.306	1.98	-1.20	.745	9.55	3.25	.00	.00
3B*	21.70	.536	17.06	-3.443	5.01	-4.21	.597	7.34	1.56	.00	.00
4B.*	21.90	.553	19.34	-5.303	2.53	-2.21	.725	9.29	3.25	.00	.00
5B*	21.50	.535	17.02	-3.583	4.65	-3.38	.596	7.25	1.69	.00	.00
1C.*	18.40	.532	15.20	-3.925	4.05	-5.03	.659	6.82	.52	.00	.00
2C.*	18.40	.522	14.36	-3.423	5.14	-5.43	.594	6.04	.39	.00	.00
4C	18.20	.537	16.66	-7.423	1.58	-.21	.749	7.74	.78	.00	.00
9C.*	18.50	.534	15.51	-4.098	3.77	-4.90	.678	7.08	.65	.00	.00
11C.*	17.70	.258	12.32	-4.241	1.73	4.12	.415	2.00	.13	.00	.00
1S	14.40	.519	12.32	-4.973	2.77	-1.90	.665	5.25	.52	.00	.00
2S.*	16.90	.494	11.91	-3.075	6.23	-3.82	.488	4.30	.13	.00	.00
3S.*	14.00	.517	11.58	-4.285	3.55	-3.73	.637	4.88	.39	.00	.00
4S.*	18.70	.523	15.17	-3.898	4.02	-3.32	.619	6.40	.39	.00	.00
5S	17.40	.525	14.57	-4.413	3.30	-2.55	.648	6.26	.39	.00	.00
6S	16.70	.528	14.34	-4.904	2.82	-2.12	.675	6.29	.39	.00	.00
1T.*	18.30	.509	12.57	-2.658	8.77	*****	.503	4.95	.26	.00	.00
2T.*	18.60	.360	12.84	-4.173	2.46	5.56	.410	2.90	.13	.00	.00
3T	18.60	.539	16.79	-6.544	1.87	-.72	.733	7.77	.52	.00	.00
4T.*	19.00	.484	12.28	-2.811	7.20	-2.13	.422	4.10	.65	.00	.00
5T.*	18.80	.437	14.66	-2.480	8.85	*****	.806	7.00	.65	.00	.00

AVERAGES: 70516 BASELINE W054 00 000											
	22.00	.551	19.86	-6.306	1.98	-1.20	.745	9.55	3.25	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
70516 W070AL003 (5E16)											
	17.06	.530	14.94	-5.651	2.47	-1.50	.694	6.66	.52	.00	.00
STD	1.48	.007	1.66	1.139	.64	.08	.040	.97	.14	*	*
PERCENT OF BASELINE											
	77.5	96.1	75.2	110.4	125	74.7	93.1	69.8	16.0	*****	*****
STDZ	6.7	1.4	8.3	18.1	32	73.8	5.3	10.1	4.4	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70608 W072CR005 (4E14) W054 00 000

\*SOL1 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.552	20.27	-6.517	1.89	-.21	.722	9.48	.00	.00	.00
1B	21.40	.555	19.70	-7.591	1.57	-.48	.765	9.61	4.81	.00	.00
2B	21.90	.552	19.89	-6.680	1.84	-.88	.749	9.58	3.90	.00	.00
3B	21.70	.552	19.91	-7.366	1.62	-.49	.759	9.62	3.90	.00	.00
4B	21.70	.549	19.52	-6.097	2.07	-1.41	.742	9.35	3.25	.00	.00
5B.*	22.40	.549	19.95	-5.730	2.25	-1.38	.726	9.44	2.34	.00	.00
1S	18.80	.524	16.94	-6.499	1.83	-.64	.730	7.61	1.30	.00	.00
2S	19.50	.162	12.36	-3.815	1.28	2.86	.365	1.22	.13	.00	.00
3S.*	20.80	.387	13.69	-4.056	2.72	6.40	.380	3.24	.13	.00	.00
4S.*	20.40	.527	17.02	-4.099	3.65	-3.57	.660	7.51	.78	.00	.00
5S.*	20.10	.244	13.00	-3.601	2.13	3.26	.381	1.98	.13	.00	.00
1C	21.20	.541	19.36	-7.119	1.66	-.46	.750	9.10	2.34	.00	.00
2C.*	21.30	.528	16.37	-3.137	5.96	-6.52	.594	7.06	.78	.00	.00
3C.*	21.40	.533	17.31	-3.557	4.70	-5.40	.644	7.76	1.04	.00	.00
4C	21.30	.541	19.31	-6.656	1.81	-.73	.743	9.05	2.21	.00	.00
5C	21.40	.544	19.65	-7.466	1.57	-.38	.759	9.34	2.60	.00	.00
6C	21.50	.541	19.55	-6.825	1.75	-.63	.746	9.18	2.21	.00	.00
7C	21.30	.541	19.19	-6.336	1.94	-.90	.736	8.97	1.95	.00	.00
8C	21.50	.542	19.69	-7.329	1.60	-.34	.753	9.28	2.34	.00	.00
9C	21.40	.544	19.57	-7.187	1.65	-.46	.753	9.26	2.60	.00	.00
10C.*	19.00	.132	12.24	-4.964	.68	3.34	.356	.94	.13	.00	.00
11C	20.30	.163	13.02	-3.644	1.39	2.34	.375	1.31	.13	.00	.00
1T	21.30	.537	18.99	-5.859	2.14	-1.19	.724	8.75	1.69	.00	.00
2T	20.80	.537	18.79	-6.470	1.87	-.89	.740	8.74	1.87	.00	.00
3T	21.00	.538	18.95	-6.356	1.92	-1.05	.741	8.85	1.95	.00	.00
4T	20.90	.535	18.82	-6.363	1.91	-.85	.735	8.69	1.56	.00	.00
5T	20.70	.535	18.97	-7.422	1.56	-.22	.751	8.80	1.87	.00	.00
6T	20.90	.536	18.74	-6.097	2.03	-1.10	.731	8.66	1.87	.00	.00
AVERAGES: 70608 BASELINE W054 00 000											
	21.68	.552	19.75	-6.933	1.77	-.81	.754	9.54	3.97	.00	.00
STD	.18	.002	.16	.588	.20	.38	.009	.11	.56	*	*
70608 W072CR005 (4E14)											
	20.86	.401	18.25	-6.340	1.74	-.29	.696	7.93	1.79	.00	.00
STD	.73	.124	2.19	1.091	.22	1.13	.124	2.55	.71	*	*
PERCENT OF BASELINE											
	96.3	89.0	92.4	108.6	98	164.4	92.3	83.1	45.1	*****	*****
STD%	4.2	23.0	11.9	24.8	5	220.2	17.7	28.0	26.8	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70609A W073CR-MN NI-TI-V001(4E14-4E14-8E15-2.4E12-4E12) WO 00 000  
 \*SOL1 1 /7 /80 AMI: P0=91.60M<sup>4</sup>/CM<sup>2</sup> NO AR COATING

ID	ISC	VCC	IP	LOG(I0)	N	R	FF	Eff	IOD	PCDa	PCDb
1R*	22.50	.555	20.34	-6.757	1.81	.01	.724	9.56	.00	.00	.00
1B	22.60	.556	21.17	-9.733	1.19	.28	.783	10.40	5.20	.00	.00
2B	22.50	.553	20.93	-8.673	1.31	.16	.771	10.15	5.46	.00	.00
3B	22.90	.556	21.46	-9.578	1.17	.44	.779	10.49	5.98	.00	.00
4B	22.70	.555	21.26	-9.519	1.18	.46	.778	10.36	5.72	.00	.00
5B	22.60	.554	21.16	-9.405	1.19	.28	.782	10.35	5.20	.00	.00
1C	17.20	.500	15.56	-6.962	1.61	.14	.723	6.58	.65	.00	.00
2C	17.50	.500	15.70	-6.480	1.77	-.22	.716	6.62	.78	.00	.00
3C	17.50	.500	15.66	-6.356	1.82	-.25	.712	6.58	.52	.00	.00
4C	17.50	.501	15.75	-6.688	1.82	.04	.716	6.64	.52	.00	.00
5C	17.40	.497	15.35	-5.824	2.04	-.44	.693	6.33	.78	.00	.00
6C	17.50	.499	15.54	-6.131	1.91	-.05	.696	6.43	.65	.00	.00
7C	17.10	.503	15.39	-6.644	1.72	-.12	.719	6.54	.65	.00	.00
8C	17.20	.503	15.42	-6.453	1.79	-.25	.715	6.54	.52	.00	.00
9C	17.20	.501	15.47	-6.661	1.71	.04	.715	6.52	.52	.00	.00
10C	16.90	.488	14.04	-4.460	3.03	-1.39	.625	5.46	.52	.00	.00
11C	17.50	.498	15.29	-5.476	2.24	-.80	.684	6.31	.65	.00	.00
1S	17.80	.511	16.09	-6.849	1.67	-.05	.725	6.97	.52	.00	.00
2S	17.50	.505	15.80	-6.761	1.69	-.10	.723	6.76	.65	.00	.00
3S	17.70	.505	15.90	-6.410	1.81	-.58	.723	6.84	.65	.00	.00
4S	17.70	.504	15.91	-6.538	1.76	-.20	.718	6.77	.65	.00	.00
5S	17.90	.503	15.53	-5.236	2.41	-1.09	.678	6.46	.52	.00	.00
1T	17.30	.500	15.54	-6.618	1.72	.08	.712	6.52	.78	.00	.00
2T	17.30	.498	15.51	-6.539	1.74	.11	.708	6.45	.73	.00	.00
3T	17.30	.500	15.51	-6.519	1.76	-.01	.711	6.51	.78	.00	.00
4T	17.20	.499	15.44	-6.612	1.72	.12	.711	6.45	.65	.00	.00
5T	17.20	.498	15.49	-6.843	1.64	.41	.711	6.44	.78	.00	.00
6T	17.10	.497	15.25	-6.382	1.80	.23	.699	6.28	.39	.00	.00

AVERAGES: 70509A BASELINE W054 00 000

	22.66	.555	21.20	-9.321	1.21	.33	.779	10.35	5.51	.00	.00
STD	.14	.001	.17	.330	.05	.11	.004	.11	.30	*	*
	70609A W073CR-MN NI-TI-V001(4E14-4E14-8E15-2.4E12-4E12)										
	17.39	.500	15.51	-6.328	1.87	-.20	.706	6.50	.63	.00	.00
STD	.24	.004	.38	.584	.32	.42	.021	.28	.11	*	*
PERCENT OF BASELINE											
	76.7	90.2	73.2	132.0	154	-61.2	90.7	62.8	11.5	*****	*****
STD%	1.5	1.0	2.4	8.9	34	195.9	3.2	3.4	2.8	*****	*****



TABLE 16 SOLAR CELL I-V DATA (Cont.)

70610 W074MN-CR-NI-TI-V002(8E13-8E13-2E15-3.3E11-6E11) W054 00 000  
 \*SOL1 1 / 7 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	I0G(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.16	-6.256	2.01	-.36	.717	9.47	.00	.00	.00
1B	22.00	.554	20.19	-7.413	1.61	-.39	.758	9.77	4.68	.00	.00
2B	22.20	.554	20.38	-7.417	1.61	-.47	.761	9.89	4.55	.00	.00
3B	22.30	.551	20.31	-6.983	1.73	-.41	.745	9.68	4.94	.00	.00
4B	22.50	.551	20.63	-7.362	1.61	-.40	.757	9.93	4.55	.00	.00
5B.*	22.30	.551	19.88	-5.765	2.24	-1.40	.727	9.45	4.29	.00	.00
1C	20.70	.541	18.81	-6.158	1.78	-.78	.747	8.85	1.82	.00	.00
2C	20.60	.538	18.56	-6.399	1.91	-.77	.733	8.59	1.30	.00	.00
3C	20.80	.539	18.83	580	1.84	-.79	.741	8.79	1.56	.00	.00
4C	20.80	.540	18.97	5	1.63	-.46	.748	8.88	1.82	.00	.00
5C	20.60	.538	18.53	-6.310	1.94	-.85	.732	8.58	1.69	.00	.00
6C	21.00	.537	18.98	-6.514	1.85	-.76	.738	8.80	1.56	.00	.00
7C	21.10	.537	18.97	-6.275	1.85	-.84	.731	8.75	1.56	.00	.00
8C	20.90	.539	18.95	-6.674	1.80	-.76	.744	8.86	1.82	.00	.00
9C	21.20	.539	19.06	-6.565	1.92	-.53	.725	8.76	1.95	.00	.00
10C	21.10	.539	19.17	-6.836	1.74	-.51	.742	8.93	1.95	.00	.00
11C	20.50	.533	18.30	-5.999	2.07	-.92	.720	8.32	1.30	.00	.00
1S	20.60	.545	18.83	-7.229	1.64	-.37	.750	8.91	2.34	.00	.00
2S	21.10	.543	18.79	-5.832	2.18	-1.15	.720	8.73	1.95	.00	.00
3S	21.30	.545	19.34	-6.800	1.77	-.51	.741	9.10	2.60	.00	.00
4S	21.30	.545	19.53	-7.387	1.59	-.38	.756	9.28	2.60	.00	.00
5S	21.40	.546	18.94	-5.567	2.34	-1.43	.716	8.84	2.60	.00	.00
1T	20.10	.539	18.16	-6.606	1.83	-.50	.732	8.39	1.30	.00	.00
2T	20.30	.538	18.40	-6.776	1.77	-.44	.737	8.51	1.30	.00	.00
3T	20.50	.538	18.57	-6.591	1.83	-.87	.744	8.67	1.56	.00	.00
4T	20.40	.536	18.44	-6.722	1.78	-.21	.728	8.41	1.69	.00	.00
5T	20.70	.539	18.90	-7.138	1.65	-.44	.749	8.84	1.69	.00	.00
6T	20.40	.537	18.46	-6.639	1.81	-.65	.738	8.55	1.69	.00	.00
AVERAGES: 70610 BASELINE W054 00 000											
	22.25	.553	20.38	-7.294	1.64	-.42	.755	9.82	4.68	.00	.00
STD	.18	.002	.16	.181	.05	.03	.006	.10	.16	*	*
70610 W074MN-CR-NI-TI-V002(8E13-8E13-2E15-3.3E11-6E11)											
	20.79	.540	18.79	-6.593	1.85	-.68	.737	8.74	1.80	.00	.00
STD	.35	.003	.33	.426	.17	.27	.010	.22	.40	*	*
PERCENT OF BASELINE											
	93.	97.7	92.2	109.6	113	37.5	97.6	89.0	38.5	*****	*****
STD%	2.5	.9	2.4	8.2	14	82.1	2	3.2	10.2	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70614 W075TI-V002 (5.6E13-1E14) W054 00 000

\*SOL2 1 // /80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.554	20.33	-6.747	1.81	.01	.723	9.53	.00	.00	.00
1B.*	22.20	.548	19.81	-5.876	2.17	-1.16	.725	9.33	3.38	.00	.00
2B	22.10	.548	20.03	-6.636	1.84	-.69	.742	9.50	3.90	.00	.00
3B	22.20	.549	20.16	-6.682	1.82	-.83	.748	9.65	3.90	.00	.00
4B	22.20	.549	20.42	-7.620	1.54	-.27	.760	9.80	4.16	.00	.00
1C	15.40	.486	13.79	-6.604	1.69	.38	.702	5.56	.22	.00	.00
2C	15.30	.485	13.62	-6.309	1.80	.03	.699	5.49	.13	.00	.00
3C	15.50	.483	13.79	-6.250	1.82	-.09	.700	5.54	.39	.00	.00
4C	15.50	.483	13.70	-5.953	1.95	-.45	.696	5.51	.39	.00	.00
5C	15.40	.482	13.55	-5.923	1.96	.06	.681	5.35	.91	.00	.00
6C	15.40	.479	13.48	-5.732	2.00	-.16	.677	5.28	.65	.00	.00
7C	15.40	.483	13.66	-6.190	1.84	.08	.693	5.45	.91	.00	.00
8C	15.50	.482	13.71	-6.178	1.84	.44	.684	5.40	.91	.00	.00
9C.*	15.40	.478	12.71	-4.214	3.32	-3.15	.634	4.94	.39	.00	.00
10C	15.70	.483	13.91	-6.176	1.85	.24	.689	5.52	.91	.00	.00
11C	15.60	.480	13.66	-5.729	2.04	-.14	.677	5.36	.91	.00	.00
1S	15.70	.483	13.80	-5.747	2.05	-.59	.689	5.53	.91	.00	.00
2S	15.60	.486	13.91	-6.255	1.83	-.36	.707	5.67	.39	.00	.00
3S	15.90	.486	14.12	-6.117	1.88	-.35	.701	5.73	1.04	.00	.00
4S	15.70	.486	13.97	-6.158	1.86	-.41	.705	5.69	.65	.00	.00
1T	15.10	.483	13.51	-6.568	1.70	.30	.703	5.42	.65	.00	.00
2T	15.10	.480	13.40	-6.316	1.78	.47	.689	5.28	.65	.00	.00
3T	15.10	.481	13.51	-6.608	1.68	.46	.700	5.38	.65	.00	.00
4T	15.10	.481	13.22	-5.823	2.01	.23	.672	5.16	.91	.00	.00
5T	15.30	.482	13.68	-6.545	1.70	.31	.702	5.47	.91	.00	.00
6T	15.30	.483	13.68	-6.514	1.72	.17	.704	5.50	.91	.00	.00
AVERAGES: 70614 BASELINE W054 00 000											
	22.17	.549	20.21	-6.980	1.73	-.59	.750	9.65	3.99	.00	.00
STD	.05	.000	.16	.453	.14	.24	.008	.12	.12	*	*
70614 W075TI-V002 (5.6E13-1E14)											
	15.43	.483	13.68	-6.185	1.85	.03	.694	5.47	.70	.00	.00
STD	.22	.002	.20	.287	.12	.32	.010	.14	.26	*	*
PERCENT OF BASELINE											
	69.6	88.0	67.7	111.4	107	205.2	92.5	56.6	17.6	*****	*****
STD%	1.2	.4	1.6	10.1	16	79.0	2.3	2.2	7.3	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70613 W076POLY002 W054 00 000

\*SOL1 1 / 7 / 80 AM1: PO 1.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	GCD	PCDa	PCDb
1R*	22.50	.553	20.18	-6.315	1.98	-.30	.717	9.44	.00	.00	.00
1B*	21.70	.542	18.85	-4.932	2.77	-2.11	.698	8.68	2.99	.00	.00
2B	22.30	.549	20.39	-7.257	1.64	-.23	.748	9.69	5.46	.00	.00
3B	22.30	.550	20.28	-6.777	1.79	-.74	.749	9.72	4.55	.00	.00
4B*	21.70	.543	19.03	-5.208	2.56	-1.88	.710	8.84	3.51	.00	.00
5B	22.10	.548	20.03	-6.636	1.84	-.68	.742	9.50	5.20	.00	.00
1C	18.40	.508	16.24	-6.051	1.97	.43	.680	6.72	1.04	.00	.00
2C	19.00	.505	16.18	-4.936	2.62	-.50	.646	6.55	.78	.00	.00
3C	18.70	.509	15.92	-5.170	2.47	.59	.631	6.35	.91	.00	.00
4C	18.50	.510	16.34	-5.942	2.02	-.07	.690	6.88	1.04	.00	.00
5C	18.80	.506	16.23	-5.452	2.27	.51	.649	6.53	.78	.00	.00
6C	19.40	.507	16.55	-5.092	2.51	.11	.640	6.66	.91	.00	.00
7C	19.30	.512	17.06	-6.040	1.98	.27	.685	7.16	1.04	.00	.00
8C	19.80	.512	17.17	-5.222	2.43	-.80	.674	7.23	1.04	.00	.00
9C	19.00	.504	16.31	-4.927	2.63	-1.33	.658	6.77	.91	.00	.00
10C	19.20	.514	17.05	-6.011	2.00	-.39	.703	7.34	.91	.00	.00
11C.*	19.00	.359	14.12	-4.258	2.36	3.45	.469	3.39	.39	.00	.00
1S.*	18.70	.412	14.40	-4.475	2.50	3.40	.500	4.07	.39	.00	.00
2S	19.30	.514	17.27	-6.241	1.90	-.47	.715	7.51	1.17	.00	.00
3S	19.40	.509	16.15	-4.220	3.39	-2.65	.645	6.74	.78	.00	.00
4S	18.50	.492	15.52	-4.592	2.87	-1.10	.635	6.12	.52	.00	.00
5S.*	17.90	.427	13.47	-4.310	2.78	3.92	.481	3.89	.26	.00	.00
6J	18.60	.416	14.15	-4.211	2.80	2.85	.497	4.06	.26	.00	.00
7S	18.10	.481	14.58	-3.997	3.56	-1.83	.597	5.49	3.90	.00	.00
1T	20.70	.528	18.61	-6.421	1.86	-.37	.722	8.34	1.30	.00	.00
2T	19.70	.519	17.57	-6.170	1.94	-.26	.707	7.64	1.04	.00	.00
3T	20.20	.515	17.50	-5.130	2.50	-1.12	.679	7.47	.78	.00	.00
4T	20.00	.523	17.88	-6.244	1.92	-.28	.711	7.86	1.17	.00	.00
5T	19.50	.514	17.26	-5.894	2.00	-.39	.698	7.40	1.04	.00	.00
6T	19.70	.517	17.50	-5.970	2.03	-.51	.705	7.60	1.04	.00	.00
AVERAGES: 70613 BASELINE W054 00 000											
	22.23	.549	20.23	-6.890	1.76	-.55	.746	9.63	5.07	.00	.00
STD	.10	.001	.15	.265	.09	.23	.003	.09	.38	*	*
70613 W076POLY002											
	19.23	.505	16.52	-5.425	2.37	-.35	.666	6.88	1.06	.00	.00
STD	.64	.022	1.03	.731	.48	1.05	.050	.89	.67	*	*
PERCENT OF BASELINE											
	86.5	92.1	81.1	121.3	135	136.8	89.2	71.4	21.0	*****	*****
STDZ	3.3	4.2	5.8	14.1	35	293.7	7.1	10.0	15.8	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70615 W077M0001 (4.2E12) W054 00 000

\*SOL2 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.551	20.12	-6.149	2.04	-.43	.714	9.37	.00	.00	.00
1B	22.70	.551	20.79	-7.302	1.63	-.32	.753	9.96	5.60	.00	.00
2B	22.00	.548	20.07	-7.072	1.69	-.42	.748	9.54	4.40	.00	.00
3B	22.70	.550	20.98	-7.956	1.46	-.19	.767	10.13	5.20	.00	.00
4B	22.30	.549	20.41	-7.236	1.64	-.45	.755	9.77	5.20	.00	.00
5B	22.60	.549	20.76	-7.672	1.52	.06	.751	9.85	4.55	.00	.00
1C	19.10	.504	17.07	-6.152	1.90	-.66	.718	7.30	.52	.00	.00
2C	18.70	.504	16.74	-6.190	1.89	-.73	.720	7.18	1.04	.00	.00
3C	18.80	.504	16.72	-5.886	2.02	-1.01	.715	7.16	.91	.00	.00
4C	18.80	.503	16.39	-5.214	2.41	-1.60	.694	6.94	.91	.00	.00
5C	18.70	.505	16.78	-6.267	1.86	-.82	.726	7.25	.78	.00	.00
6C	18.80	.505	16.82	-6.100	1.93	-1.02	.725	7.28	.91	.00	.00
7C	18.60	.503	16.24	-5.160	2.45	-2.04	.702	6.95	.91	.00	.00
8C	19.50	.506	17.23	-5.672	2.13	-1.01	.706	7.37	.91	.00	.00
9C	18.70	.503	16.62	-5.912	2.01	-.86	.711	7.08	.65	.00	.00
10C	18.80	.504	16.87	-6.317	1.83	-.64	.723	7.25	.91	.00	.00
1S	18.40	.505	16.51	-6.221	1.88	-1.01	.729	7.17	.65	.00	.00
2S	18.80	.505	16.91	-6.455	1.78	-.52	.725	7.28	.78	.00	.00
3S	19.00	.505	17.03	-6.250	1.86	-.70	.723	7.33	.65	.00	.00
4S	19.00	.503	16.98	-6.099	1.92	-.83	.720	7.28	.78	.00	.00
5S	19.00	.503	17.11	-6.524	1.75	-.44	.726	7.34	.91	.00	.00
1T	19.50	.508	17.47	-6.179	1.90	-.81	.724	7.58	.91	.00	.00
2T	19.30	.508	17.41	-6.533	1.76	-.58	.731	7.58	.91	.00	.00
3T	19.40	.507	17.39	-6.243	1.87	-.71	.723	7.52	.91	.00	.00
4T	19.40	.507	17.42	-6.261	1.86	-.85	.728	7.58	1.04	.00	.00
5T	19.30	.506	17.35	-6.373	1.81	-.63	.726	7.50	1.04	.00	.00
6T	19.40	.505	17.30	-6.046	1.95	-.72	.715	7.41	1.17	.00	.00
AVERAGES: 70615 BASELINE W054 00 000											
	22.46	.549	20.60	-7.448	1.59	-.26	.755	9.85	4.99	.00	.00
STD	.27	.001	.32	.321	.09	.18	.007	.19	.45	*	*
70615 W077M0001 (4.2E12)											
	19.00	.505	16.97	-6.093	1.94	-.87	.720	7.30	.87	.00	.00
STD	.32	.002	.35	.357	.18	.35	.009	.18	.15	*	*
PERCENT OF BASELINE											
	84.6	91.9	82.4	118.1	122	*****	95.4	74.1	17.4	*****	*****
STD%	2.5	.5	3.0	8.5	19	457.5	2.1	3.4	4.9	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70721 W080PH001 (7E14) W054 00 000  
 \*SOL2 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.553	20.18	-6.347	1.97	-.21	.715	9.41	.00	.00	.00
1B	21.50	.547	19.73	-7.456	1.58	-.29	.755	9.39	3.90	.00	.00
2B	21.90	.549	19.82	-6.514	1.82	-.86	.743	9.44	3.90	.00	.00
3B	21.40	.546	19.30	-6.312	1.96	-1.11	.741	9.16	3.25	.00	.00
4B	21.60	.546	19.64	-6.823	1.77	-.64	.747	9.31	3.25	.00	.00
1C	22.30	.550	20.37	-7.120	1.68	-.41	.750	9.73	4.55	.00	.00
2C	22.10	.549	20.13	-6.905	1.75	-.59	.748	9.60	4.94	.00	.00
3C	22.20	.550	20.18	-6.794	1.79	-.64	.746	9.64	5.85	.00	.00
4C	22.30	.549	20.47	-7.540	1.56	-.11	.752	9.74	5.20	.00	.00
5C	22.10	.546	20.03	-6.741	1.79	-.41	.737	9.40	5.46	.00	.00
6C	22.20	.546	19.73	-5.860	2.17	-.69	.709	9.09	4.55	.00	.00
7C	22.10	.549	20.24	-7.245	1.64	-.52	.757	9.72	5.85	.00	.00
8C	22.00	.546	19.66	-5.939	2.13	-1.10	.726	9.22	4.55	.00	.00
9C	22.00	.545	19.87	-6.545	1.86	-.51	.732	9.29	5.20	.00	.00
1S	21.70	.548	19.77	-6.961	1.73	-.53	.748	9.40	4.55	.00	.00
2S	22.10	.550	20.38	-7.973	1.45	.11	.757	9.72	6.50	.00	.00
3S	22.00	.548	20.16	-7.347	1.61	-.35	.755	9.62	5.85	.00	.00
4S	22.00	.546	19.90	-6.570	1.86	-.63	.737	9.37	5.20	.00	.00
5S	21.90	.547	20.05	-7.315	1.62	-.32	.753	9.53	5.85	.00	.00
1T	21.70	.548	19.87	-7.440	1.58	-.04	.747	9.39	5.20	.00	.00
2T	21.90	.548	19.98	-7.101	1.68	-.32	.746	9.46	4.55	.00	.00
3T	21.90	.546	19.92	-6.892	1.74	-.44	.743	9.39	4.81	.00	.00
4T	22.30	.546	20.04	-6.250	1.98	-.71	.728	9.37	4.55	.00	.00
5T	22.30	.547	20.34	-7.162	1.66	-.10	.741	9.55	5.59	.00	.00
AVERAGES: 70721 BASELINE W054 00 000											
	21.60	.547	19.62	-6.776	1.80	-.73	.746	9.33	3.58	.00	.00
STD	.17	.001	.19	.432	.15	.30	.005	.11	.33	*	*
70721 W080PH001 (7E14)											
	22.06	.548	20.06	-6.932	1.75	-.44	.743	9.49	5.20	.00	.00
STD	.18	.002	.23	.522	.18	.27	.012	.16	.58	*	*
PERCENT OF BASELINE											
	102.1	100.1	102.2	97.7	97	139.8	99.5	101.7	145.5	*****	*** **
STD%	1.7	.5	2.2	14.7	19	78.3	2.3	3.1	30.9	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70725 W081N-NI001 (6.9E15) W060 00 000

\*SOL2 1 / 7 / 80 AMI: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.557	20.26	-6.511	1.91	-.18	.721	9.55	.00	.00	.00
1B	21.40	.557	19.42	-7.077	1.72	.30	.724	9.13	7.80	.00	.00
2B	22.10	.568	20.62	-9.078	1.28	.34	.774	10.27	9.10	.00	.00
3B	21.50	.560	19.80	-7.945	1.49	.29	.750	9.55	7.80	.00	.00
4B	21.30	.559	19.57	-7.810	1.52	.32	.745	9.38	6.76	.00	.00
1C	21.20	.541	17.89	-4.407	3.31	-2.34	.660	8.01	1.95	.00	.00
2C	21.10	.540	17.52	-4.140	3.66	-2.70	.644	7.75	1.56	.00	.00
3C	20.90	.294	15.99	-3.727	2.39	.04	.529	3.44	1.69	.00	.00
4C	21.40	.466	17.08	-4.656	2.61	2.62	.536	5.65	1.04	.00	.00
5C	21.30	.372	16.88	-4.159	2.50	.66	.551	4.62	.65	.00	.00
6CNS	20.60	.371	16.30	-4.353	2.32	1.46	.539	4.35	1.30	.00	.00
7CNS	21.00	.369	16.41	-4.087	2.56	.93	.535	4.38	1.30	.00	.00
8CNS	20.80	.357	16.28	-4.140	2.42	1.04	.535	4.20	.91	.00	.00
9CNS	20.80	.360	16.17	-4.089	2.50	1.11	.528	4.18	.91	.00	.00
10CNS	21.30	.414	17.01	-4.298	2.63	.98	.555	5.17	1.56	.00	.00
1S	21.00	.513	17.04	-4.229	3.36	-.22	.587	6.69	1.56	.00	.00
2S	21.50	.447	16.61	-4.309	2.83	2.68	.508	5.16	1.82	.00	.00
3S	21.10	.498	16.79	-4.100	3.43	.28	.562	6.25	.65	.00	.00
4S	21.30	.436	16.61	-4.274	2.80	2.06	.522	5.12	1.17	.00	.00
5S	21.10	.519	16.98	-3.891	3.91	-1.92	.598	6.92	.78	.00	.00
1T	21.90	.335	17.35	-3.798	2.61	-.88	.576	4.47	1.95	.00	.00
2T	21.30	.345	16.56	-3.958	2.52	.54	.536	4.16	1.82	.00	.00
3T	21.20	.411	16.85	-4.401	2.52	1.61	.542	4.99	2.34	.00	.00
4T	21.40	.365	16.64	-4.107	2.50	1.21	.527	4.35	1.30	.00	.00

AVERAGES: 70725 BASELINE W060 00 000

	21.58	.561	19.85	-7.978	1.50	.31	.748	9.58	7.87	.00	.00
STD	.31	.004	.46	.716	.16	.02	.018	.42	.83	*	*
	70725 W081N-NI001 (6.9E15)										
	21.17	.419	16.79	-4.164	2.81	.48	.556	5.26	1.38	.00	.00
STD	.29	.074	.47	.219	.46	1.49	.040	1.26	.47	*	*
	PERCENT OF BASELINE										
	98.1	74.5	84.6	147.8	187	153.8	74.3	54.8	17.6	*****	*****
STD%	2.8	13.8	4.4	7.7	53	512.3	7.2	16.1	8.5	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70726 W082N-V001 (4E14) W060 00 000

\*SOL2 1 /7 /80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.553	20.21	-6.394	1.95	-.24	.718	9.45	.00	.00	.00
1B.*	21.60	.551	19.30	-5.984	2.13	-.98	.723	9.10	6.50	.00	.00
2B	21.40	.555	19.69	-7.782	1.52	.07	.753	9.45	6.50	.00	.00
3HFB	21.90	.562	20.24	-7.992	1.48	-.10	.766	9.97	9.10	.00	.00
4HFB	21.40	.552	19.61	-7.453	1.59	-.15	.751	9.38	6.54	.00	.00
1CNS	17.70	.511	15.39	-6.333	1.87	-.33	.712	6.62	1.69	.00	.00
3CNS	17.70	.514	16.08	-6.346	1.87	-.80	.727	7.07	.91	.00	.00
4CNS	17.00	.512	15.99	-6.962	1.64	-.40	.739	7.04	.91	.00	.00
5CNS	17.70	.512	15.95	-6.542	1.79	-.61	.729	6.99	1.56	.00	.00
6CNS	17.60	.510	15.72	-6.246	1.90	-.39	.711	6.75	1.56	.00	.00
7C	17.50	.512	15.69	-6.281	1.89	-.86	.725	6.87	.91	.00	.00
8C	17.50	.510	15.44	-5.662	2.18	-1.21	.705	6.65	1.04	.00	.00
9C	17.70	.510	15.88	-6.262	1.89	-.94	.727	6.94	1.30	.00	.00
10C	17.90	.512	16.70	-6.398	1.84	-.83	.730	7.07	1.30	.00	.00
1S	17.60	.513	15.79	-6.478	1.81	-.19	.715	6.33	1.30	.00	.00
2S	17.30	.513	15.61	-6.723	1.73	-.20	.724	6.80	1.04	.00	.00
3S	17.70	.514	15.97	-6.656	1.75	-.35	.726	6.99	1.04	.00	.00
4S	17.60	.513	15.88	-6.678	1.74	-.28	.725	6.72	1.69	.00	.00
1T	17.20	.503	14.83	-5.023	2.58	-1.66	.677	6.19	.78	.00	.00
2T	17.10	.508	14.86	-5.246	2.44	-1.37	.683	6.28	1.30	.00	.00
3T	17.10	.504	14.85	-5.341	2.36	-.81	.675	6.15	.78	.00	.00
4T	17.40	.509	15.51	-6.151	1.94	-.45	.709	6.64	1.82	.00	.00
5T.*	17.30	.508	12.93	-3.692	4.38	.56	.506	4.70	1.56	.00	.00
6T	17.50	.495	14.60	-4.444	3.08	-1.78	.636	5.82	.78	.00	.00
AVERAGES: 70726 BASELINE W060 00 000											
	21.57	.556	19.85	-7.743	1.53	-.08	.756	9.60	7.38	.00	.00
STD	.24	.004	.28	.22	.05	.11	.007	.26	1.22	*	*
70726 W082N-V001 (4E14)											
	17.51	.510	15.56	-6.098	2.02	-.75	.710	6.70	1.21	.00	.00
STD	.24	.005	.46	.658	.36	.47	.025	.35	.34	*	*
PERCENT OF BASELINE											
	81.2	91.6	78.4	121.2	132	*****	93.8	69.8	16.3	*****	*****
STDZ	2.0	1.5	3.5	11.0	28	*****	4.3	5.7	8.0	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70829 W083NFE001 (1E15) W060 00 000 <70412>  
 \*SOL2 1 / 7 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1CB	22.70	.567	21.12	-8.705	1.34	.22	.770	10.48	9.10	.00	.00
2CB	22.60	.561	20.99	-8.550	1.36	.17	.769	10.30	9.10	.00	.00
3CB	22.90	.568	21.41	-9.248	1.25	.30	.779	10.71	3.25	.00	.00
4CB	22.90	.565	21.18	-8.093	1.46	-.03	.765	10.47	9.10	.00	.00
5CB	22.80	.568	21.05	-.944	1.51	-.07	.762	10.44	9.10	.00	.00
1C	19.50	.535	16.97	-5.098	2.64	-1.88	.694	7.66	1.30	.00	.00
2C	20.00	.539	17.53	-5.400	2.43	-1.20	.696	7.93	2.21	.00	.00
3C	19.10	.534	16.74	-5.394	2.43	-1.40	.698	7.53	1.69	.00	.00
4C.*	18.50	.526	15.50	-4.151	3.63	-4.33	.671	6.91	1.56	.00	.00
5C	20.30	.543	18.39	-6.654	1.83	-.70	.740	8.62	2.34	.00	.00
6C	19.40	.534	17.23	-5.890	2.14	-.83	.710	7.77	1.82	.00	.00
7C	19.30	.529	16.99	-5.726	2.20	-.42	.690	7.45	1.69	.00	.00
8C	20.90	.542	17.88	-4.644	3.05	-2.27	.677	8.11	2.34	.00	.00
9C	20.50	.545	18.70	-7.220	1.65	-.11	.742	8.76	3.51	.00	.00
10C	18.80	.530	16.26	-4.833	2.85	-2.86	.699	7.36	1.04	.00	.00
11C	21.00	.544	19.00	-6.915	1.73	.23	.721	8.71	4.55	.00	.00
12C	21.30	.545	18.59	-5.368	2.46	-.69	.682	8.37	3.77	.00	.00
1S	21.40	.550	19.50	-7.204	1.66	.09	.735	9.15	5.85	.00	.00
2S	21.50	.548	19.54	-7.037	1.70	.03	.732	9.12	4.55	.00	.00
5S.*	21.50	.547	17.29	-3.448	5.11	-6.24	.644	8.01	4.55	.00	.00
1T	17.70	.514	15.43	-5.542	2.27	-.25	.673	6.48	1.69	.00	.00
2T	18.30	.521	16.18	-5.824	2.13	-.61	.698	7.04	.91	.00	.00
3T	18.00	.521	16.07	-6.217	1.95	-.37	.709	7.03	1.95	.00	.00
4T	18.40	.525	16.31	-5.888	2.11	-.73	.705	7.20	1.04	.00	.00
5T	18.00	.523	15.94	-5.911	2.10	-.56	.701	6.98	1.69	.00	.00
AVERAGES: 70829 BASELINE W060 00 000 <70412>											
	22.78	.566	21.15	-8.550	1.38	.12	.769	10.30	7.93	.00	.00
STD	.12	.003	.15	.64	.09	.14	.006	.13	2.34	*	*
70829 W083NFE001 (1F15)											
	19.63	.535	17.40	-5.932	2.18	-.81	.706	7.85	2.44	.00	.00
STD	1.24	.010	1.26	.772	.39	.91	.020	.77	1.37	*	*
PERCENT OF BASELINE											
	86.2	94.5	82.3	130.3	158	*****	91.8	74.9	30.8	*****	*****
STD%	5.9	2.3	6.5	13.4	41	*****	3.3	8.4	31.5	*****	*****



TABLE 16 SOLAR CELL I-V DATA (Cont.)

71104 W084N/AL001 (5E16) W078 00 000

\*SOL6 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.558	20.09	-6.064	2.11	-.55	.714	9.49	.00	.00	.00
1B*	22.30	.555	19.70	-5.485	2.42	-1.41	.713	9.33	3.90	.00	.00
2B.*	22.50	.551	20.01	-5.753	2.24	-1.14	.719	9.43	3.64	.00	.00
3B	22.70	.553	20.47	-5.369	1.95	-.80	.736	9.77	3.90	.00	.00
4B*	22.20	.546	19.39	-5.126	2.63	-1.73	.701	8.99	2.99	.00	.00
5B.*	22.90	.551	20.19	-5.472	2.40	-1.16	.706	9.42	3.90	.00	.00
1C	19.50	.520	16.68	-4.955	2.68	-.81	.656	7.04	.65	.00	.00
2C	20.10	.527	17.70	-5.618	2.25	-.77	.696	7.80	.91	.00	.00
3C	19.80	.525	17.47	-5.674	2.21	-.82	.700	7.69	.78	.00	.00
4C	20.20	.526	17.26	-4.987	2.67	-.44	.649	7.30	.78	.00	.00
5C	20.00	.526	17.54	-5.449	2.34	-.01	.694	7.72	.78	.00	.00
6C	20.10	.523	17.37	-5.022	2.63	-1.41	.679	7.55	.65	.00	.00
7C	20.20	.525	17.50	-5.226	2.48	-.68	.671	7.53	.78	.00	.00
8C	19.90	.524	17.11	-4.926	2.71	-1.37	.671	7.40	.78	.00	.00
9C	19.70	.526	17.37	-5.863	2.11	-.03	.686	7.52	.78	.00	.00
10C	20.00	.525	17.37	-5.187	2.51	-1.14	.682	7.57	.78	.00	.00
11C	19.70	.525	17.30	-5.565	2.27	-.76	.692	7.57	.65	.00	.00
12C	19.60	.521	16.94	-5.048	2.61	-1.37	.678	7.33	.65	.00	.00
13C	19.60	.520	16.94	-5.061	2.59	-1.26	.676	7.29	.65	.00	.00
1S	20.80	.528	17.97	-5.120	2.57	-.82	.670	7.79	.78	.00	.00
2S	19.80	.523	17.28	-5.381	2.38	-.78	.685	7.48	.78	.00	.00
3S	20.00	.524	17.44	-5.534	2.28	-.04	.670	7.43	.91	.00	.00
4S	20.30	.525	17.59	-5.240	2.47	-.61	.671	7.56	.91	.00	.00
5S	19.90	.526	17.30	-5.306	2.44	-.71	.677	7.49	.78	.00	.00
1T	19.50	.523	16.66	-4.821	2.81	-1.40	.663	7.15	.78	.00	.00
2T	20.00	.529	17.55	-5.499	2.33	-.90	.693	7.76	.91	.00	.00
3T	19.30	.524	17.05	-5.789	2.15	-.59	.698	7.47	.91	.00	.00
4T	19.60	.525	17.21	-5.534	2.29	-.85	.693	7.54	.91	.00	.00
5T	19.70	.527	17.46	-5.889	2.10	-.56	.703	7.71	1.04	.00	.00
6T	20.00	.525	17.44	-5.239	2.48	-1.30	.690	7.66	.91	.00	.00
AVERAGES: 71104 BASELINE W078 00 000											
	22.70	.553	20.47	-6.369	1.95	-.80	.736	9.77	3.90	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
71104 W084N/AL001 (5E16)											
	19.89	.525	17.31	-5.331	2.43	-.85	.681	7.51	.80	.00	.00
STD	.31	.002	.30	.304	.20	.38	.014	.19	.10	*	*
PERCENT OF BASELINE											
	87.6	94.9	84.6	116.3	124	93.2	92.5	76.9	20.6	*****	*****
STD%	1.4	.0	1.4	4.8	10	47.4	1.9	2.0	2.7	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80524 W085N/ZR001 (7E11) REPEAT W079 00 000

\*SOL9 1 /8 /80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.556	19.67	-6.001	2.14	-1.55	.742	9.56	.00	.00	.00
1B	21.20	.546	19.27	-7.121	1.67	.15	.730	8.94	5.20	.00	.00
2B*	21.40	.540	19.28	-6.534	1.85	-.22	.722	8.83	4.55	.00	.00
3B	21.70	.546	19.69	-6.936	1.73	-.03	.730	9.15	5.85	.00	.00
4B	21.70	.550	19.75	-6.975	1.73	-.38	.743	9.38	4.29	.00	.00
5B*	21.40	.525	17.98	-4.455	3.15	-1.56	.645	7.66	1.56	.00	.00
1C	21.90	.553	18.32	-4.508	3.24	-.85	.629	8.06	7.15	.00	.00
2C	21.40	.547	19.73	-7.995	1.44	.18	.755	9.34	5.20	.00	.00
3C	21.50	.548	19.85	-7.986	1.45	-.01	.761	9.48	5.20	.00	.00
1S	21.20	.547	19.54	-7.876	1.47	.00	.757	9.29	5.85	.00	.00
2S	21.70	.553	19.96	-7.671	1.54	-.14	.757	9.60	8.18	.00	.00
2T	21.00	.546	19.02	-6.703	1.81	-.48	.736	8.93	5.20	.00	.00
3T	21.60	.553	19.99	-3.239	1.41	.10	.764	9.64	5.20	.00	.00
AVERAGES: 80524 BASELINE W079 00 000											
	21.53	.547	19.57	-7.010	1.71	-.08	.735	9.16	5.11	.00	.00
STD	.24	.002	.21	.080	.03	.22	.006	.18	.64	*	*
80524 W085N/ZR001 (7E11) REPEAT											
	21.47	.550	19.49	-7.283	1.77	-.17	.737	9.19	6.00	.00	.00
STD	.28	.003	.57	1.222	.62	.34	.045	.51	1.11	*	*
PERCENT OF BASELINE											
	99.7	100.4	99.6	96.1	103	-5.3	100.3	100.4	117.3	*****	*****
STD%	2.4	.9	4.0	18.8	38	*****	7.0	7.7	39.1	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70926 W086C001 POLY (4E17) W078 00 000

\*SOL6 1 / 8 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.556	20.23	-6.452	1.93	-.15	.718	9.49	.00	.00	.00
1B	21.50	.553	19.82	-7.732	1.52	-.37	.766	9.63	3.51	.00	.00
2B	21.70	.555	20.08	-8.062	1.45	-.25	.771	9.82	4.94	.00	.00
3B	21.50	.553	19.73	-7.399	1.61	-.48	.760	9.55	4.94	.00	.00
4B	21.40	.552	19.61	-7.295	1.64	-.56	.759	9.48	4.16	.00	.00
5B	21.60	.552	19.94	-7.824	1.50	-.37	.768	9.69	4.94	.00	.00
1C	21.50	.549	19.16	-5.768	2.24	-1.44	.727	9.07	3.64	.00	.00
2C	21.50	.551	19.78	-7.527	1.57	-.54	.766	9.59	4.55	.00	.00
3C	21.60	.551	19.53	-6.714	1.82	-.87	.750	9.44	3.90	.00	.00
4C	21.30	.553	19.44	-7.061	1.71	-.53	.750	9.35	4.29	.00	.00
5C	21.60	.552	19.18	-5.569	2.36	-1.79	.727	9.17	3.64	.00	.00
6C	21.00	.546	18.12	-4.690	3.03	-2.93	.700	8.48	2.60	.00	.00
7C	21.40	.549	18.97	-5.544	2.37	-1.74	.724	8.99	3.14	.00	.00
8C	21.50	.550	19.24	-5.865	2.19	-1.63	.737	9.22	3.90	.00	.00
9C	21.80	.551	19.70	-6.413	1.94	-1.03	.744	9.45	3.64	.00	.00
10C	21.70	.551	19.59	-6.328	1.97	-1.13	.743	9.40	3.90	.00	.00
11C	21.60	.549	19.08	-5.468	2.41	-1.61	.716	8.98	3.25	.00	.00
1S	21.50	.547	18.76	-4.998	2.74	-2.38	.709	8.82	2.99	.00	.00
2S	21.50	.551	19.44	-6.415	1.94	-1.13	.746	9.35	4.29	.00	.00
3S	21.40	.543	18.76	-5.242	2.54	-1.74	.706	8.68	2.60	.00	.00
4S	21.30	.549	19.43	-6.922	1.75	-.88	.757	9.36	3.64	.00	.00
5S	21.60	.550	19.77	-7.214	1.66	-.54	.756	9.50	4.16	.00	.00
1T	21.50	.544	18.50	-4.805	2.90	-2.12	.688	8.51	2.34	.00	.00
2T	21.50	.550	19.19	-5.813	2.22	-1.47	.730	9.13	3.64	.00	.00
3T	21.80	.548	19.24	-5.418	2.44	-1.65	.715	9.04	3.12	.00	.00
4T	21.50	.548	19.54	-6.748	1.80	-.79	.748	9.32	3.38	.00	.00
5T	21.90	.548	19.71	-6.138	2.04	-1.35	.743	9.42	3.38	.00	.00
6T	21.90	.548	19.65	-6.002	2.11	-1.40	.738	9.37	3.90	.00	.00
AVERAGES: 70926 BASELINE W078 00 000											
	21.54	.553	19.84	-7.662	1.54	-.40	.765	9.63	4.50	.00	.00
STD	.10	.001	.16	.281	.07	.11	.005	.11	.58	*	*
70926 W086C001 POLY (4E17)											
	21.54	.549	19.27	-6.030	2.17	-1.39	.733	9.16	3.54	.00	.00
STD	.20	.002	.42	.773	.39	.60	.020	.31	.57	*	*
PERCENT OF BASELINE											
	100.0	99.3	97.1	121.3	141	*****	95.8	95.1	78.7	*****	* **
STD%	1.4	.6	2.9	13.3	33	277.7	3.2	4.4	24.4	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70930 W087CA001 (UNKNOWN) BI CRYSTAL W078 00 000  
 \*SOL6 1 / 8 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.557	20.17	-6.303	2.00	-.27	.716	9.48	.00	.00	.00
1B	22.50	.553	20.21	-6.094	2.08	-1.16	.736	9.68	4.29	.00	.00
2B	22.80	.556	20.83	-7.135	1.69	-.41	.751	10.06	4.55	.00	.00
3B.*	22.40	.549	20.05	-5.972	2.12	-1.14	.730	9.49	3.90	.00	.00
4B.*	22.50	.550	19.90	-5.475	2.40	-1.57	.718	9.40	3.90	.00	.00
5B	22.50	.550	20.20	-6.214	2.01	-.70	.726	9.50	4.55	.00	.00
1C	22.70	.549	20.34	-6.301	1.97	-.22	.714	9.41	4.55	.00	.00
2C	22.00	.555	20.82	-7.878	1.49	.12	.754	10.00	5.59	.00	.00
3C	22.30	.552	20.08	-6.354	1.96	-.66	.730	9.51	4.16	.00	.00
4C	22.40	.556	20.08	-6.107	2.08	-.87	.726	9.57	4.42	.00	.00
5C	22.50	.552	19.93	-5.609	2.33	-.23	.715	9.38	3.90	.00	.00
6C	22.40	.553	20.17	-6.338	1.97	-.72	.732	9.58	4.29	.00	.00
7C	22.30	.551	20.08	-6.260	2.00	-.93	.735	9.55	3.90	.00	.00
8C	23.10	.555	21.04	-7.003	1.73	-.27	.742	10.06	5.20	.00	.00
9C	22.70	.556	20.87	-7.561	1.57	-.27	.759	10.13	4.55	.00	.00
10C	22.50	.551	20.04	-5.814	2.21	-1.07	.720	9.44	3.90	.00	.00
1S	22.60	.558	20.50	-6.664	1.86	-.71	.744	9.92	4.94	.00	.00
2S	22.60	.555	20.55	-6.828	1.79	-.58	.746	9.89	4.55	.00	.00
3S	22.60	.553	20.11	-5.729	2.26	-1.27	.722	9.55	4.55	.00	.00
4S	22.60	.552	20.30	-6.115	2.06	-1.10	.735	9.70	4.42	.00	.00
5S	22.60	.551	20.30	-6.137	2.05	-1.00	.733	9.65	4.81	.00	.00
1T	22.70	.550	19.93	-5.323	2.50	-1.35	.703	9.28	4.42	.00	.00
2T	22.60	.553	20.40	-6.493	1.91	-.53	.732	9.67	3.51	.00	.00
3T	22.60	.551	20.01	-5.583	2.34	-1.28	.715	9.42	3.77	.00	.00
4T	22.60	.550	19.98	-5.565	2.34	-1.16	.710	9.34	3.77	.00	.00
5T	22.80	.552	20.66	-6.676	1.83	-.47	.737	9.81	4.55	.00	.00
AVERAGES: 70930 BASELINE W078 00 000											
	22.60	.553	20.41	-6.481	1.93	-.75	.733	9.75	4.46	.00	.00
STD	.14	.002	.30	.465	.17	.31	.010	.23	.12	*	*
70930 W087CA001 (UNKNOWN) BI CRYSTAL											
	22.59	.553	20.31	-6.317	2.01	-.78	.730	9.64	4.3	.00	.00
STD	.17	.002	.32	.645	.26	.41	.014	.24	.50	*	*
PERCENT OF BASELINE											
	100.0	100.0	99.5	102.5	104	96.7	99.0	98.9	98.3	*****	*****
STD%	1.4	.9	3.1	17.7	24	117.7	3.3	5.0	14.2	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70919 W\*088C001 LOW RESISTIVITY (5E14) 0.5 OHMCM W058 00 000  
 \*SOL6 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.558	20.18	-0.311	2.00	-.27	.716	9.51	.00	.00	.00
1F.*	20.10	.561	16.98	-4.784	3.04	-.44	.635	7.57	.65	.00	.00
2B	20.90	.595	18.98	-6.821	1.93	-.61	.743	9.77	1.56	.00	.00
3B.*	20.90	.576	17.59	-4.563	3.34	-1.27	.641	8.15	.91	.00	.00
4B	20.50	.595	18.99	-8.208	1.52	-.19	.771	9.95	1.69	.00	.00
5B	21.00	.596	19.40	-7.903	1.60	-.36	.769	10.17	1.56	.00	.00
2C	21.50	.585	18.38	-4.641	3.29	-2.27	.675	8.98	1.04	.00	.00
3C	20.60	.552	17.55	-5.254	2.58	1.07	.625	7.51	.65	.00	.00
4C	20.60	.594	18.61	-6.460	2.08	-1.00	.740	9.57	1.56	.00	.00
5C	21.50	.596	19.51	-6.701	1.98	-.77	.744	10.08	1.69	.00	.00
6C	21.40	.599	19.69	-7.568	1.70	-.55	.766	10.38	1.95	.00	.00
7C	20.70	.587	17.92	-4.759	3.19	-2.57	.689	8.89	1.04	.00	.00
8C	20.50	.594	18.72	-7.080	1.84	-.74	.755	9.72	1.56	.00	.00
9C	20.80	.431	15.33	-3.659	3.63	1.31	.487	4.62	.52	.00	.00
1S	21.30	.592	19.21	-6.379	2.10	-.92	.736	9.81	1.56	.00	.00
2S	21.50	.574	18.07	-4.388	3.52	-2.11	.650	8.48	.65	.00	.00
3S	21.50	.574	18.12	-4.573	3.30	-1.24	.643	8.39	.65	.00	.00
4S	21.10	.586	19.00	-6.371	2.08	-.74	.730	9.54	1.17	.00	.00
5S	21.50	.597	20.02	-8.615	1.44	-.17	.781	10.60	1.95	.00	.00
1T	21.20	.569	17.69	-4.337	3.57	-1.85	.638	8.14	.91	.00	.00
2T	20.60	.587	18.23	-5.559	2.53	-1.69	.717	9.17	1.30	.00	.00
3T	20.80	.565	17.63	-4.788	3.04	-.65	.642	7.98	.65	.00	.00
4T	20.50	.580	17.74	-4.953	2.97	-1.99	.687	8.64	.91	.00	.00

AVERAGES: 70919 BASELINE W058 00 000

20.80 .595 19.12 -7.644 1.69 -.38 .761 9.96 1.60 .00 .00

STD .22 .000 .19 .595 .18 .17 .013 .17 .06 \* \*

70919 W\*088C001 LOW RESISTIVITY (5E14) 0.5 OHMCM

21.04 .574 18.32 -5.652 2.64 -.99 .688 8.85 1.16 .00 .00

STD .39 .038 1.05 1.306 .70 1.04 .070 1.35 .46 \* \*

PERCENT OF BASELINE

101.2 96.5 95.8 126.1 156 -58.3 90.5 88.9 72.5 \*\*\*\*\* \*\*\*\*\*

STD% 3.0 6.5 6.5 24.2 53 504.0 10.8 15.3 32.7 \*\*\*\*\* \*\*\*\*\*

TABLE 16 SOLAR CELL I-V DATA (Cont.)

70922 W\*089CU001 LOW RESISTIVITY (2E15) W058 00 000  
 \*SOL6 1 / 8 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.559	20.18	-6.289	2.01	-.36	.718	9.55	2.54	.00	.00
1B.*	20.30	.586	17.97	-5.585	2.51	-1.67	.717	9.02	2.34	.00	.00
2B.*	20.20	.582	17.41	-4.806	3.12	-2.49	.688	8.55	2.34	.00	.00
3B	20.90	.594	18.90	-6.710	1.97	-.31	.730	9.59	1.82	.00	.00
4B	20.30	.590	18.80	-8.131	1.53	-.34	.773	9.79	1.56	.00	.00
1C	21.30	.589	18.57	-5.036	2.92	-2.28	.703	9.32	2.60	.00	.00
2C.*	21.20	.585	17.69	-4.067	4.08	-3.98	.663	8.69	1.04	.00	.00
3C	21.40	.599	19.86	-8.319	1.50	-.18	.774	10.50	2.60	.00	.00
4C	21.30	.597	19.54	-7.368	1.75	-.56	.760	10.22	1.95	.00	.00
5C	21.20	.598	19.59	-7.949	1.59	-.34	.770	10.32	2.60	.00	.00
6C	21.20	.597	19.57	-7.825	1.62	-.40	.68	10.23	2.60	.00	.00
7C	21.40	.581	18.45	-4.917	2.99	-1.59	.677	8.91	1.04	.00	.00
8C	21.10	.586	18.61	-5.461	2.59	-1.63	.71	9.30	1.30	.00	.00
9C	21.30	.574	17.93	-4.518	3.37	-1.49	.64	8.33	.78	.00	.00
10	21.40	.596	19.36	-6.491	2.06	-1.02	.743	10.02	1.95	.00	.00
2S	21.10	.595	19.45	-7.734	1.64	-.40	.765	10.16	1.56	.00	.00
3S	21.40	.596	19.10	-5.740	2.45	-1.92	.735	9.91	2.21	.00	.00
4S	21.40	.589	18.93	-5.552	2.53	-1.53	.715	9.52	1.56	.00	.00
5S	21.30	.590	18.68	-5.205	2.79	-2.09	.709	9.42	1.56	.00	.00
1T	21.30	.595	19.34	-6.745	1.96	-.77	.745	9.99	1.82	.00	.00
2T	21.50	.595	19.32	-6.162	2.21	-1.20	.735	9.94	1.56	.00	.00
3T	21.40	.604	19.85	-8.213	1.54	-.37	.777	10.62	2.60	.00	.00
4T	20.70	.597	19.05	-7.510	1.71	-.70	.770	10.06	2.34	.00	.00
5T	21.30	.601	19.90	-9.001	1.37	-.08	.786	10.64	2.60	.00	.00
6T	21.50	.599	20.03	-8.724	1.42	-.06	.780	10.62	2.60	.00	.00
AVERAGES: 70922 BASELINE W058 00 000											
	20.60	.592	18.85	-7.421	1.75	-.32	.752	9.69	1.69	.00	.00
STD	.30	.002	.05	.711	.22	.01	.022	.10	.13	*	*
70922 W*089CU001 LOW RESISTIVITY (2E15)											
	21.29	.594	19.22	-6.762	2.11	-.99	.740	9.90	1.92	.00	.00
STD	.18	.007	.56	1.382	.60	.00	.038	.61	.58	*	*
PERCENT OF BASELINE											
	103.3	100.3	101.9	108.9	120	*****	98.5	102.2	113.8	*****	*****
STL%	2.4	1.5	3.2	29.1	54	230.7	8.0	7.4	45.8	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

71028 W\*090MN001 LOW RESISTIVITY (7E14) W058 00 000  
 \*SOL 1 1 / 8 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OGD	PCDa	PCDb
1R*	22.50	.551	20.12	-6.149	2.04	-.43	.714	9.37	.00	.00	.00
1B*	20.80	.518	16.50	-4.075	3.61	.27	.560	6.38	.39	.00	.00
2B.*	20.90	.586	18.39	-5.402	2.63	-1.63	.707	9.16	1.04	.00	.00
3B*	21.00	.544	16.99	-4.169	3.65	-.41	.586	7.08	.52	.00	.00
4B.*	20.70	.578	17.74	-4.749	3.15	-2.03	.674	8.53	1.04	.00	.00
5B	20.40	.587	18.55	-6.955	1.86	-.41	.741	9.38	1.30	.00	.00
1C.*	19.60	.582	16.78	-4.563	3.40	-3.51	.690	8.33	1.04	.00	.00
2C	17.90	.580	16.18	-6.678	1.96	-.68	.735	8.06	1.04	.00	.00
3C	20.50	.547	16.58	-4.143	3.72	-.67	.589	6.98	.52	.00	.00
4C	19.00	.532	15.54	-4.361	3.37	-.33	.597	6.38	.65	.00	.00
5C*	19.10	.477	14.96	-4.038	3.43	.61	.544	5.24	.52	.00	.00
6C*	19.80	.487	15.69	-4.065	3.44	.16	.559	5.70	.52	.00	.00
7C	19.10	.567	16.23	-4.707	3.17	-1.72	.657	7.53	.91	.00	.00
8C*	19.80	.502	15.38	-3.902	3.81	.27	.540	5.68	.39	.00	.00
9C	20.10	.564	16.72	-4.296	3.62	-2.06	.635	7.61	.65	.00	.00
10C	20.10	.549	16.12	-4.039	3.91	-.84	.581	6.78	.65	.00	.00
11C	18.00	.582	16.69	-8.489	1.44	.17	.766	8.49	1.17	.00	.00
1S*	17.90	.486	14.07	-4.174	3.34	1.19	.542	4.99	.65	.00	.00
2S	18.90	.583	16.54	-5.302	2.72	-1.82	.699	8.15	.78	.00	.00
3S	20.30	.593	18.56	-7.193	1.80	-.57	.753	9.59	1.30	.00	.00
4S	20.00	.593	18.67	-8.939	1.37	-.06	.783	9.83	1.69	.00	.00
5S*	20.00	.504	15.92	-4.136	3.45	.34	.562	5.99	.52	.00	.00
1T.*	17.50	.570	14.67	-4.315	3.72	-3.68	.659	6.95	.91	.00	.00
2T*	19.80	.525	16.06	-4.364	3.30	.45	.579	6.37	.52	.00	.00
3T*	17.70	.527	14.14	-3.979	3.95	-1.59	.583	5.76	.52	.00	.00
4T.*	19.70	.476	13.63	-3.238	5.15	.66	.450	4.46	.39	.00	.00
5T	19.00	.556	15.59	-4.296	3.61	-1.10	.608	6.79	.39	.00	.00
AVERAGES: 71028 BASELINE W058 00 000											
	20.40	.587	18.55	-6.955	1.86	-.41	.741	9.38	1.30	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
71028 W*090MN001 LOW RESISTIVITY (7E14)											
	19.35	.568	16.67	-5.677	2.79	-.88	.673	7.84	.89	.00	.00
STD	.86	.019	.99	1.746	.93	.69	.073	1.08	.37	*	*
PERCENT OF BASELINE											
	94.9	96.7	89.9	118.4	150	-16.2	90.8	83.5	68.2	*****	*****
STDZ	4.2	3.3	5.3	25.1	50	170.5	9.9	11.5	28.2	*****	*****

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TABLE 16 SOLAR CELL I-V DATA (Cont.)

71031 W091CR-MN002 (5E14-3E14) W078 00 000

\*SOL6 1 / 8 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.551	20.01	-5.905	2.16	-.63	.710	9.31	.00	.00	.00
1B.*	22.40	.547	20.01	-5.944	2.13	-1.02	.724	9.39	4.16	.00	.00
2B.*	22.40	.548	20.04	-5.965	2.12	-1.14	.729	9.47	3.51	.00	.00
3B	22.20	.548	20.08	-6.595	1.85	-.55	.736	9.47	4.29	.00	.00
4B.*	22.10	.544	19.23	-5.029	2.69	-1.77	.696	8.85	2.60	.00	.00
1C	15.60	.474	13.48	-5.253	2.30	-.93	.669	5.24	.65	.00	.00
2C	17.50	.500	15.63	-6.352	1.82	-.02	.705	6.52	.91	.00	.00
3C	16.70	.489	14.74	-5.792	2.03	-.79	.699	6.04	.91	.00	.00
4C	17.10	.495	15.15	-5.940	1.98	-.54	.700	6.27	.65	.00	.00
5C	16.80	.492	14.38	-4.881	2.65	-1.74	.658	5.84	.65	.00	.00
6C	15.70	.476	13.39	-4.920	2.55	-1.35	.657	5.20	.65	.00	.00
7C	17.50	.501	15.72	-6.543	1.75	-.17	.717	6.65	.78	.00	.00
8C	17.80	.500	15.56	-5.420	2.28	-1.10	.690	6.49	.65	.00	.00
9C	16.70	.483	14.10	-4.645	2.81	-1.75	.650	5.54	.52	.00	.00
10C	15.40	.474	13.14	-4.872	2.59	-1.80	.663	5.12	.65	.00	.00
1S	17.80	.504	15.80	-5.888	2.03	-.91	.709	6.73	.65	.00	.00
2S	17.10	.498	15.14	-5.922	2.00	-.56	.700	6.30	.78	.00	.00
3S	17.20	.499	15.25	-5.900	2.02	-.83	.706	6.41	.91	.00	.00
4S	17.80	.502	15.63	-5.529	2.22	-1.12	.696	6.58	.78	.00	.00
5S	17.50	.498	15.27	-5.398	2.28	-1.02	.685	6.32	.65	.00	.00
1T	16.00	.484	13.79	-5.168	2.40	-1.00	.667	5.46	.65	.00	.00
2T	16.50	.484	14.41	-5.554	2.14	-.53	.679	5.74	.78	.00	.00
3T	16.10	.480	14.00	-5.420	2.21	-.74	.676	5.53	.78	.00	.00
4T	16.00	.480	13.88	-5.342	2.26	-.84	.674	5.47	.78	.00	.00
5T	15.90	.478	13.61	-4.962	2.52	-1.41	.663	5.33	.65	.00	.00
6T	15.90	.476	13.39	-4.593	2.84	-2.07	.650	5.20	.78	.00	.00

AVERAGES: 71031 BASELINE W078 00 000

	22.20	.548	20.08	-6.595	1.85	-.55	.736	9.47	4.29	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
	71031 W091CR-MN002 (5E14-3E14)										
	16.70	.489	14.55	-5.442	2.27	-1.01	.682	5.90	.72	.00	.00
STD	.78	.010	.88	.521	.30	.52	.020	.54	.10	*	*
PERCENT OF BASELINE											
	75.2	89.2	72.4	117.5	123	16.1	92.7	62.3	16.9	*****	*****
STD%	3.5	1.9	4.4	7.9	16	94.8	2.7	5.8	2.4	*****	*****



TABLE 16 SOLAR CELL I-V DATA (Cont.)

71101 W092PH002 (2.8E16) W078 00 000

\*SOL6 1 / 8 / 80 AMI: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.11	-6.138	2.06	-.40	.713	9.41	.00	.00	.00
1B	22.40	.550	20.05	-6.113	2.06	-.69	.721	9.39	4.55	.00	.00
2B	22.10	.553	20.02	-6.608	1.87	-.74	.742	9.59	4.55	.00	.00
3B.*	22.30	.550	19.85	-5.724	2.26	-1.37	.724	9.40	3.90	.00	.00
4B.*	21.80	.545	17.69	-3.556	4.79	-5.61	.650	8.16	3.12	.00	.00
5B.*	22.40	.547	19.13	-4.490	3.22	-2.71	.684	8.86	2.60	.00	.00
1C	22.30	.566	19.52	-5.144	2.71	-1.91	.706	9.43	3.51	.00	.00
2C	22.10	.561	19.05	-4.751	3.03	-2.29	.690	9.04	3.12	.00	.00
3C	22.30	.550	18.66	-4.275	3.50	-2.18	.648	8.40	1.30	.00	.00
4C	22.60	.564	19.78	-5.134	2.70	-1.90	.707	9.53	5.20	.00	.00
5C	22.10	.562	19.22	-4.960	2.84	-2.13	.700	9.19	2.73	.00	.00
6C	22.40	.565	19.60	-5.136	2.71	-1.86	.705	9.43	3.90	.00	.00
7C	22.60	.562	19.78	-5.104	2.71	-1.99	.708	9.51	4.55	.00	.00
8C	21.70	.564	19.30	-5.705	2.33	-1.48	.724	9.37	3.38	.00	.00
9C	22.40	.567	19.89	-5.672	2.35	-1.32	.719	9.66	4.55	.00	.00
10C	22.40	.566	19.51	-4.987	2.83	-2.10	.702	9.41	2.99	.00	.00
11C	22.00	.563	19.08	-4.894	2.91	-2.17	.696	9.12	2.99	.00	.00
12C	22.20	.565	19.64	-5.490	2.46	-1.60	.718	9.52	4.16	.00	.00
1S	22.20	.568	19.85	-5.918	2.23	-1.28	.730	9.73	4.55	.00	.00
2S	21.70	.565	18.85	-4.844	2.97	-2.71	.706	9.16	3.64	.00	.00
3S	22.30	.565	19.56	-5.234	2.63	-1.70	.706	9.40	3.25	.00	.00
4S	22.10	.565	19.45	-5.353	2.55	-1.62	.710	9.38	3.64	.00	.00
5S	22.50	.565	19.81	-5.319	2.57	-1.76	.714	9.59	3.90	.00	.00
1T	21.90	.563	19.43	-5.760	2.29	-.94	.711	9.27	4.16	.00	.00
2T	22.00	.567	19.68	-6.045	2.16	-.93	.724	9.55	3.51	.00	.00
3T	22.30	.562	20.13	-6.467	1.95	-.66	.734	9.73	4.68	.00	.00
4T	22.10	.561	19.93	-6.445	1.96	-.59	.731	9.58	4.55	.00	.00
5T	22.50	.559	19.80	-5.435	2.47	-1.19	.703	9.35	3.90	.00	.00
AVERAGES: 71101 BASELINE W078 00 000											
	22.25	.552	20.04	-6.361	1.96	-.71	.732	9.49	4.55	.00	.00
STD	.15	.002	.01	.248	.10	.03	.011	.10	.00	*	*
71101 W092PH002 (2.8E16)											
	22.21	.563	19.52	-5.367	2.58	-1.65	.709	9.38	3.73	.00	.00
STD	.25	.004	.36	.528	.36	.54	.017	.28	.83	*	*
PERCENT OF BASELINE											
	99.8	102.2	97.4	115.6	132	-32.0	96.9	98.8	82.1	*****	*****
STD%	1.8	.9	1.9	11.9	26	87.4	3.8	4.0	18.2	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

71108 W093MN004 (6.6E14) W078 00 000

\*SOL6 1 / 8 / 80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.556	20.08	-6.076	2.10	-.46	.712	9.42	.00	.00	.00
1B	22.40	.548	20.32	-6.899	1.74	-.08	.731	9.50	5.85	.00	.00
2B.*	22.50	.548	19.88	-5.637	2.29	-.84	.704	9.17	4.29	.00	.00
3B*	21.40	.525	15.56	-3.164	5.82	-2.36	.506	6.01	.65	.00	.00
4B.*	22.50	.539	18.74	-4.255	3.45	-1.86	.639	8.19	1.95	.00	.00
5B.*	22.40	.545	19.37	-4.989	2.73	-1.27	.679	8.76	3.64	.00	.00
1B*	21.90	.551	19.71	-6.363	1.96	-.62	.729	9.30	4.55	.00	.00
2B*	21.90	.549	19.70	-6.346	1.96	-.62	.728	9.26	4.16	.00	.00
3B*	22.20	.547	19.59	-5.547	2.35	-1.05	.705	9.05	3.90	.00	.00
4B*	22.20	.549	19.84	-6.007	2.11	-.88	.722	9.31	3.90	.00	.00
1C	21.00	.536	18.17	-5.056	2.65	-1.24	.679	8.08	1.30	.00	.00
2C	20.70	.538	18.12	-5.287	2.49	-1.43	.698	8.22	1.04	.00	.00
3C	20.70	.531	17.49	-4.558	3.09	-1.61	.652	7.58	.91	.00	.00
4C	20.50	.531	17.84	-5.145	2.57	-1.44	.689	7.93	.91	.00	.00
5C	20.80	.529	17.85	-5.031	2.64	-.57	.657	7.65	1.04	.00	.00
6C	20.90	.533	18.16	-5.193	2.53	-1.05	.682	8.03	1.30	.00	.00
7C	20.70	.534	18.04	-5.174	2.56	-1.48	.693	8.10	1.30	.00	.00
8C	20.90	.534	18.23	-5.224	2.52	-1.31	.691	8.16	1.30	.00	.00
9C	20.60	.534	18.18	-5.545	2.31	-1.24	.707	8.23	1.30	.00	.00
10C	20.40	.528	17.58	-4.884	2.76	-1.76	.680	7.75	.78	.00	.00
11C	20.80	.534	18.50	-5.941	2.09	-.64	.710	8.33	1.30	.00	.00
12C	21.00	.539	19.08	-6.973	1.70	-.16	.735	8.80	2.08	.00	.00
1S	20.70	.536	18.11	-5.296	2.48	-1.32	.695	8.16	1.30	.00	.00
2S	21.00	.543	19.09	-6.959	1.72	-.26	.738	8.90	1.95	.00	.00
3S	21.20	.540	19.01	-6.248	1.97	-.59	.722	8.74	1.82	.00	.00
4S	20.60	.533	17.55	-4.816	2.84	-.95	.653	7.58	.91	.00	.00
5S	21.20	.544	19.35	-7.241	1.63	-.11	.743	9.06	2.21	.00	.00
1T	20.30	.532	17.82	-5.381	2.41	-1.43	.703	8.02	.91	.00	.00
2T	20.90	.535	18.55	-5.801	2.17	-.90	.711	8.41	1.96	.00	.00
3T	20.40	.528	17.63	-4.947	2.71	-1.72	.684	7.79	.91	.00	.00
4T	20.40	.529	17.79	-5.142	2.56	-1.70	.696	7.95	1.04	.00	.00
5T.*	20.40	.424	17.36	-3.334	4.28	*****	.852	7.79	.78	.00	.00
6T.*	20.40	.424	17.07	-3.159	4.78	*****	.825	7.54	.65	.00	.00
AVERAGES: 71108 BASELINE W078 00 000											
	22.40	.548	20.32	-6.899	1.74	-.08	.731	9.50	5.85	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
71108 W093MN004 (6.6E14)											
	20.75	.534	18.20	-5.516	2.40	-1.09	.696	8.16	1.31	.00	.00
STD	.25	.004	.54	.732	.38	.51	.025	.41	.43	*	*
PERCENT OF BASELINE											
	92.6	97.5	89.5	120.0	138	*****	95.2	86.0	22.4	*****	*****
STDZ	1.1	.8	2.6	10.6	22	627.5	3.4	4.4	7.3	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80509 W094MN005 (9E14)(POLY REPEAT RUN WITH 76 POLY BASE PB) W079 00 000  
 \*SOL8 1 /14/80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.558	19.75	-6.225	2.04	-1.35	.746	9.64	.00	.00	.00
1B	22.00	.549	20.08	-7.016	1.71	-.60	.752	9.61	4.55	.00	.00
2B*	22.20	.549	19.54	-5.372	2.47	-1.48	.708	9.13	3.64	.00	.00
3B	22.20	.547	20.23	-7.055	1.69	-.30	.744	9.55	3.90	.00	.00
4B*	22.20	.544	19.89	-6.155	2.02	-.67	.722	9.23	2.99	.00	.00
5B	22.40	.548	20.02	-5.952	2.13	-1.02	.725	9.41	4.55	.00	.00
1BP*	17.10	.225	10.21	-5.642	.97	8.07	.318	1.29	.00	.00	.00
2BP*	18.30	.496	16.13	-5.860	2.01	-.13	.687	6.60	.65	.00	.00
3BP*	19.40	.502	16.69	-5.003	2.55	-1.12	.669	6.89	.91	.00	.00
4BP*	19.20	.506	16.95	-5.768	2.09	-.58	.697	7.16	1.17	.00	.00
5BP*	18.90	.503	16.67	-5.773	2.07	-.46	.693	6.97	.91	.00	.00
1C*	18.60	.325	11.44	-5.578	1.41	10.12	.330	2.11	.52	.00	.00
2C*	17.80	.302	10.89	-6.828	.99	10.88	.322	1.83	.52	.00	.00
3C	20.60	.515	17.47	-4.652	2.90	-1.38	.654	7.34	.52	.00	.00
4C*	17.70	.259	10.72	-8.352	.66	10.11	.315	1.53	.52	.00	.00
5C*	16.60	.198	10.02	-8.184	.52	8.24	.314	1.09	.52	.00	.00
6C	19.10	.505	16.96	-6.070	1.94	-.17	.699	7.13	.91	.00	.00
7C*	18.90	.407	11.46	-4.666	2.31	11.28	.330	2.69	.39	.00	.00
8C*	18.50	.318	10.91	-5.428	1.44	10.58	.314	1.95	.39	.00	.00
1S*	19.10	.380	11.61	-5.138	1.86	11.20	.328	2.51	.39	.00	.00
2S	20.40	.517	17.38	-4.719	2.85	-1.46	.660	.37	.78	.00	.00
3S*	18.90	.375	11.63	-4.823	2.02	10.35	.335	2.51	.26	.00	.00
4S*	17.70	.261	10.67	-6.497	.92	9.50	.318	1.55	.00	.00	.00
1T*	16.90	.230	10.21	-8.595	.56	9.50	.314	1.29	.00	.00	.00
2T*	16.70	.192	10.00	-9.826	.40	8.36	.309	1.05	.00	.00	.00
3T*	16.70	.205	10.08	-8.246	.53	8.50	.314	1.14	.00	.00	.00
AVERAGES: 80509 BASELINE W079 00 000											
	22.20	.548	20.11	-6.674	1.84	-.64	.740	9.52	4.33	.00	.00
STD	.16	.001	.09	.511	.20	.29	.012	.08	.31	*	*
80509 W094MN005 (9E14)(POLY REPEAT RUN WITH 76 POLY BASE PB)											
	20.03	.512	17.27	-5.147	2.56	-1.00	.671	7.28	.74	.00	.00
STD	.67	.005	.22	.653	.44	.59	.020	.10	.16	*	*
PERCENT OF BASELINE											
	90.2	93.5	85.9	122.9	139	42.7	90.7	76.4	17.0	*****	*****
STDZ	3.7	1.1	1.5	16.4	42	207.3	4.1	1.8	5.2	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

71208 W095MN006 FAST GROWTH (1E15) W097 00 000  
 \*SOL6 1 / 8 / 80 AMI: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.19	-6.332	1.98	-.30	.718	9.48	.00	.00	.00
1B.*	22.80	.551	20.36	-5.951	2.14	-.90	.722	9.59	3.90	.00	.00
2B*	20.40	.525	17.65	-5.209	2.49	-.61	.669	7.58	.65	.00	.00
3B	22.70	.550	20.66	-7.009	1.71	-.21	.740	9.77	.49	.00	.00
4B.*	22.40	.546	19.87	-5.754	2.22	-.87	.710	9.19	3.25	.00	.00
5B.*	22.90	.543	19.73	-4.774	2.89	-1.87	.684	9.00	2.60	.00	.00
6B.*	22.70	.543	19.52	-4.862	2.82	-1.28	.671	8.75	3.77	.00	.00
1C	20.50	.534	18.17	-5.632	2.26	-1.47	.718	8.32	.91	.00	.00
2C	20.50	.534	18.47	-6.373	1.90	-.85	.734	8.50	1.17	.00	.00
3C	20.50	.524	17.46	-4.579	3.03	-2.24	.671	7.62	.65	.00	.00
4C	20.50	.531	18.01	-5.354	2.42	-1.59	.706	8.13	.91	.00	.00
5C	20.20	.526	17.56	-5.003	2.66	-2.11	.698	7.85	.91	.00	.00
6C	20.50	.529	17.98	-5.268	2.47	-1.77	.707	8.10	1.04	.00	.00
7C	20.30	.537	18.13	-5.911	2.13	-1.33	.728	8.39	1.17	.00	.00
8C	20.40	.533	17.66	-4.954	2.73	-1.87	.688	7.91	.91	.00	.00
9C	20.40	.528	17.60	-4.868	2.78	-1.98	.685	7.81	.78	.00	.00
10C	20.40	.528	17.46	-4.649	2.98	-2.34	.679	7.73	.78	.00	.00
11C.*	20.30	.525	16.91	-4.119	3.61	-3.28	.654	7.37	.65	.00	.00
1S	20.70	.536	18.17	-5.262	2.50	-1.89	.710	8.33	.91	.00	.00
2S	20.70	.534	18.04	-5.050	2.65	-2.05	.701	8.20	.91	.00	.00
3S	21.00	.539	18.81	-5.984	2.09	-1.34	.733	8.78	1.30	.00	.00
4S	21.00	.535	18.34	-5.110	2.60	-1.95	.704	8.36	1.17	.00	.00
5S	20.80	.535	18.48	-5.791	2.17	-1.09	.716	8.42	1.17	.00	.00
6S	20.80	.535	18.48	-5.791	2.17	-1.09	.716	8.42	1.17	.00	.00
1T.*	20.30	.523	16.81	-4.009	3.77	-3.62	.651	7.31	.52	.00	.00
2T	20.50	.527	17.65	-4.778	2.85	-2.22	.686	7.84	.65	.00	.00
3T	20.70	.526	17.65	-4.561	3.05	-2.40	.675	7.77	.52	.00	.00
4T.*	20.30	.525	17.09	-4.285	3.38	-3.06	.666	7.50	.65	.00	.00
5T	20.30	.531	17.95	-5.519	2.32	-1.68	.718	8.19	1.04	.00	.00
6T	20.60	.526	17.74	-4.789	2.83	-2.13	.685	7.85	.65	.00	.00
AVERAGES: 71208 BASELINE W097 00 000											
	22.70	.550	20.66	-7.009	1.71	-.21	.740	9.77	.49	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
71208 W095MN006 FAST GROWTH (1E15)											
	20.57	.531	17.49	-5.261	2.53	-1.77	.703	8.13	.94	.00	.00
STD	.22	.004	.38	.506	.33	.44	.019	.31	.21	*	*
PERCENT OF BASELINE											
	90.6	96.6	87.1	124.9	148	*****	95.0	83.2	189.5	*****	*****
STD%	.9	.8	1.8	7.2	19	210.4	2.5	3.1	42.9	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

71213 W096MN007 (6.3E14) W097 00 000

\*SOL6 1 / 8 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.553	20.18	-6.285	1.99	-.39	.719	9.46	.00	.00	.00
1B.*	22.50	.549	19.79	-5.289	2.52	-1.73	.712	9.31	4.16	.00	.00
2B.*	22.30	.545	19.85	-5.809	2.19	-1.04	.718	9.21	3.77	.00	.00
3B	22.20	.548	19.88	-6.100	2.06	-.82	.725	9.32	4.03	.00	.00
4B	22.20	.548	20.13	-6.626	1.84	-.79	.745	9.59	3.90	.00	.00
1C	22.50	.547	19.78	-5.315	2.49	-1.55	.708	9.22	3.64	.00	.00
2C	22.70	.548	20.21	-5.809	2.20	-1.05	.720	9.47	3.90	.00	.00
3C	22.60	.539	19.14	-4.490	3.17	-1.85	.660	8.50	2.21	.00	.00
4C	22.60	.543	19.15	-4.380	3.32	-2.54	.670	8.70	2.60	.00	.00
5C	22.30	.546	19.57	-5.228	2.55	-1.74	.708	9.12	3.25	.00	.00
6C	22.60	.548	20.09	-5.717	2.25	-1.18	.719	9.42	3.77	.00	.00
7C	22.30	.549	20.04	-6.176	2.03	-.99	.734	9.50	4.55	.00	.00
8C	22.30	.547	19.76	-5.587	2.32	-1.36	.717	9.25	4.42	.00	.00
9C	22.50	.546	19.77	-5.327	2.48	-1.45	.706	9.17	2.99	.00	.00
1S	22.40	.548	20.04	-5.990	2.11	-1.05	.728	9.44	3.38	.00	.00
2S	22.30	.546	19.80	-5.684	2.26	-1.24	.719	9.25	3.90	.00	.00
3S	22.60	.548	20.17	-5.885	2.16	-1.08	.724	9.48	4.55	.00	.00
4S	22.50	.541	19.88	-5.530	2.33	-1.23	.711	9.15	4.29	.00	.00
5S	22.40	.546	20.14	-6.220	2.00	-.90	.733	9.48	3.64	.00	.00
6S	22.40	.546	19.81	-5.482	2.38	-1.50	.716	9.27	3.64	.00	.00
1T	21.60	.541	19.16	-5.748	2.21	-.94	.711	8.78	1.95	.00	.00
2T	21.90	.535	18.88	-4.885	2.77	-1.56	.679	8.42	1.30	.00	.00
3T	22.00	.542	19.7	-6.332	1.94	-.44	.722	9.10	2.60	.00	.00
4T	22.10	.536	19.21	-5.122	2.58	-1.20	.685	8.58	1.69	.00	.00
5T	22.10	.543	20.14	-7.239	1.62	.18	.734	9.31	2.99	.00	.00
6T	22.00	.536	19.04	-4.997	2.68	-1.36	.681	8.50	1.69	.00	.00
AVERAGES: 71213 BASELINE W097 00 000											
	22.20	.548	20.01	-6.363	1.95	-.81	.735	9.45	3.97	.00	.00
STD	.00	.000	.12	.263	.11	.01	.010	.13	.06	*	*
71213 W096MN007 (6.3E14)											
	22.32	.544	19.69	-5.578	2.37	-1.24	.709	9.10	3.19	.00	.00
STD	.27	.004	.41	.632	.38	.52	.021	.36	.97	*	*
PERCENT OF BASELINE											
	100.5	99.2	98.4	112.3	122	46.1	96.5	96.3	80.4	*****	*****
STD%	1.2	.8	2.7	14.0	28	68.0	4.2	5.2	26.2	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

71214 W098 MO 002 (9.2E11) W097 00 000

\*SOL6 1 / 8 / 80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.25	-6.493	1.91	-.18	.720	9.51	.00	.00	.00
1B.*	22.70	.546	19.94	-5.328	2.48	-1.37	.704	9.23	3.51	.00	.00
2B	22.40	.547	20.20	-6.440	1.91	-.60	.732	9.48	4.29	.00	.00
3B.*	22.70	.547	19.89	-5.251	2.53	-1.41	.701	9.20	3.64	.00	.00
4B.*	22.60	.550	20.18	-5.901	2.16	-1.08	.725	9.53	3.77	.00	.00
1C	20.80	.522	18.13	-5.161	2.51	-1.46	.693	7.95	1.04	.00	.00
2C	21.10	.524	18.61	-5.632	2.21	-.79	.700	8.18	1.43	.00	.00
4C	21.00	.524	18.88	-6.413	1.85	-.37	.722	8.40	1.30	.00	.00
5C	20.80	.518	18.14	-5.214	2.45	-1.28	.691	7.87	.78	.00	.00
6C	20.80	.514	17.62	-4.631	2.91	-1.33	.651	7.37	1.04	.00	.00
7C	20.80	.521	18.37	-5.551	2.25	-1.28	.710	8.14	1.04	.00	.00
8C	20.80	.519	18.18	-5.186	2.47	-1.68	.701	8.00	1.04	.00	.00
9C	20.80	.517	18.00	-4.998	2.60	-1.53	.684	7.78	1.04	.00	.00
10C	21.00	.520	18.54	-5.529	2.26	-1.28	.710	8.19	1.04	.00	.00
11C	21.10	.519	18.38	-5.279	2.41	-.84	.682	7.90	1.04	.00	.00
1S	20.90	.527	18.65	-6.040	2.02	-.68	.716	8.34	1.30	.00	.00
2S	20.90	.527	18.58	-5.964	2.05	-.48	.706	8.22	1.17	.00	.00
3S	21.30	.526	18.82	-5.578	2.25	-1.17	.709	8.40	1.30	.00	.00
4S	21.00	.525	18.65	-5.786	2.13	-.97	.713	8.32	1.04	.00	.00
5S	20.80	.525	18.48	-5.787	2.14	-1.05	.715	8.26	1.30	.00	.00
6S	20.80	.522	18.31	-5.470	2.30	-1.23	.704	8.09	.91	.00	.00
1T	21.30	.524	18.60	-5.321	2.40	-.94	.688	8.12	1.04	.00	.00
2T	20.90	.525	18.73	-6.256	1.92	-.50	.719	8.35	1.43	.00	.00
3T	20.90	.521	18.22	-5.283	2.42	-.98	.686	7.90	.91	.00	.00
4T	20.80	.523	18.38	-5.729	2.16	-.65	.700	8.05	1.30	.00	.00
5T	20.80	.523	18.54	-5.962	2.04	-.78	.715	8.23	1.04	.00	.00
AVERAGES: 71214 BASELINE W097 00 000											
	22.40	.547	20.20	-6.440	1.91	-.60	.732	9.48	4.29	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
71214 W098 MO 002 (9.2E11)											
	20.92	.522	18.42	-5.560	2.27	-1.01	.701	8.10	1.12	.00	.00
STD	.16	.003	.29	.421	.24	.36	.016	.24	.17	*	*
PERCENT OF BASELINE											
	93.4	95.5	91.2	113.7	119	29.9	95.7	85.4	26.1	*****	*****
STD%	.7	.6	1.4	6.5	13	59.7	2.2	2.6	4.0	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

71216 W100CU-T1002 (1E15-3.3E13) W097 00 000

\*SOL7 1 / 8 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.25	-6.561	1.89	.01	.717	9.46	.00	.00	.00
1B.*	22.70	.547	20.00	-5.490	2.38	-1.05	.703	9.23	3.64	.00	.00
2B.*	22.80	.540	19.07	-4.320	3.37	-1.73	.642	8.36	2.08	.00	.00
3B.*	22.70	.546	19.80	-5.136	2.61	-1.43	.694	9.10	3.25	.00	.00
4B	22.70	.550	20.46	-6.378	1.94	-.70	.733	9.68	4.42	.00	.00
5B	22.70	.552	20.50	-6.413	1.93	-.82	.739	9.79	4.55	.00	.00
1C	15.40	.488	13.57	-6.009	1.94	.21	.682	5.42	.91	.00	.00
2C	15.60	.486	13.59	-5.625	2.13	-.06	.670	5.37	.91	.00	.00
3C	15.50	.486	13.66	-6.016	1.93	.20	.682	5.44	1.04	.00	.00
4C	15.70	.484	13.63	-5.513	2.18	-.14	.666	5.35	.91	.00	.00
5C	15.90	.488	13.94	-5.822	2.03	.08	.677	5.55	.78	.00	.00
6C	15.60	.484	13.61	-5.659	2.10	-.09	.672	5.37	.78	.00	.00
7C	15.40	.484	13.45	-5.679	2.09	-.10	.673	5.30	.91	.00	.00
8C	16.20	.486	14.00	-5.337	2.29	-.42	.663	5.52	.91	.00	.00
9C	16.20	.485	14.00	-5.329	2.29	-.42	.663	5.51	.91	.00	.00
10C	15.20	.483	12.95	-5.027	2.51	-.71	.648	5.03	.91	.00	.00
11C	15.60	.489	13.69	-5.803	2.04	-.14	.681	5.49	.91	.00	.00
12C	15.70	.486	13.64	-5.561	2.16	.01	.665	5.36	.52	.00	.00
1S	15.70	.490	13.81	-5.861	2.02	-.11	.683	5.56	1.04	.00	.00
2S	15.50	.486	13.61	-5.870	2.00	.11	.678	5.40	.91	.00	.00
3S	16.00	.489	13.93	-5.564	2.17	-.23	.671	5.55	.91	.00	.00
4S	15.80	.487	13.75	-5.550	2.17	-.25	.671	5.46	.91	.00	.00
5S	15.80	.489	13.85	-5.766	2.06	-.17	.680	5.56	1.04	.00	.00
6S	15.50	.487	13.67	-6.102	1.90	.49	.679	5.42	1.04	.00	.00
1T	15.30	.486	13.14	-5.256	2.36	-.30	.654	5.14	.91	.00	.00
2T	15.40	.489	13.52	-5.913	1.99	.27	.676	5.38	1.04	.00	.00
3T	15.70	.491	13.81	-5.870	2.02	-.11	.684	5.57	.65	.00	.00
4T	15.50	.488	13.65	-6.052	1.92	.52	.676	5.41	.91	.00	.00
5T	15.60	.489	13.75	-6.029	1.93	.25	.682	5.50	.91	.00	.00

AVERAGES: 71216 BASELINE W097 00 000

	22.70	.551	20.48	-6.395	1.94	-.76	.736	9.74	4.49	.00	.00
STD	.00	.001	.02	.017	.00	.06	.003	.05	.06	*	*

71216 W100CU-T1002 (1E15-3.3E13)

	15.64	.487	13.66	-5.705	2.10	-.05	.673	5.42	.90	.00	.00
STD	.25	.002	.24	.277	.15	.29	.009	.13	.12	*	*

PERCENT OF BASELINE

	68.9	88.4	66.7	110.8	108	193.6	91.4	55.7	20.0	*****	*****
STD%	1.1	.5	1.2	4.6	8	40.9	1.6	1.6	3.0	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80106 W102TI006 POLY (1.1E14) W097 00 000

\*SOL7 1 / 8 / 80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.552	20.24	-6.402	1.94	-.36	.723	9.49	.00	.00	.00
1B	22.80	.547	20.54	-6.381	1.93	-.58	.730	9.63	3.90	.00	.00
2B.*	22.70	.545	20.08	-5.582	2.31	-1.13	.711	9.30	3.51	.00	.00
3B.*	23.30	.548	20.36	-5.156	2.60	-1.45	.698	9.42	3.25	.00	.00
4B	23.30	.549	20.88	-6.144	2.03	-.64	.722	9.77	4.29	.00	.00
1C	14.00	.457	11.77	-4.810	2.58	-.87	.633	4.28	.39	.00	.00
2C	13.90	.450	11.34	-4.207	3.20	-2.58	.614	4.06	.39	.00	.00
3C.*	13.00	.382	8.77	-4.180	2.78	8.61	.398	2.09	.26	.00	.00
4C.*	13.60	.420	9.68	-3.377	4.60	-1.25	.480	2.90	.26	.00	.00
5C.*	13.60	.433	9.89	-3.231	5.23	-5.34	.519	3.23	.26	.00	.00
6C.*	13.50	.528	9.42	-4.795	3.01	13.44	.407	3.06	.26	.00	.00
7C	13.10	.421	9.78	-3.933	3.42	1.88	.497	2.90	.26	.00	.00
8C.*	13.60	.429	10.31	-3.577	4.17	-3.16	.544	3.36	.26	.00	.00
9C	13.60	.451	11.37	-4.706	2.65	-1.15	.629	4.08	.78	.00	.00
10C.*	13.30	.442	10.49	-3.758	3.91	-4.55	.592	3.68	.39	.00	.00
11C	13.70	.445	10.99	-4.056	3.39	-2.51	.595	3.83	.52	.00	.00
1S	14.10	.462	12.25	-5.667	2.02	.29	.661	4.56	.91	.00	.00
2S	13.10	.446	10.89	-4.574	2.77	-1.67	.626	3.87	.65	.00	.00
3S.*	14.20	.438	10.45	-3.217	5.27	-6.08	.506	3.53	.39	.00	.00
1T.*	13.70	.453	10.91	-3.845	3.81	-4.26	.601	3.94	.91	.00	.00
2T.*	13.20	.439	9.97	-3.465	4.59	-4.94	.551	3.38	.39	.00	.00
3T	13.50	.453	11.27	-4.622	2.75	-1.68	.633	4.09	.91	.00	.00
4T	13.80	.456	11.53	-4.655	2.72	-1.39	.631	4.20	.91	.00	.00
5T.*	13.30	.432	9.81	-3.433	4.60	-3.29	.520	3.16	.26	.00	.00
6T.*	13.20	.445	10.26	-3.726	4.01	-3.71	.570	3.54	.52	.00	.00

AVERAGES: 80106 BASELINE W097 00 000

	23.05	.548	20.71	-6.263	1.98	-.61	.726	9.70	4.10	.00	.00
STD	.25	.001	.17	.118	.05	.03	.004	.07	.19	*	*

80106 W102TI006 POLY (1.1E14)

	13.64	.449	11.24	-4.581	2.83	-1.08	.613	3.99	.64	.00	.00
STD	.34	.011	.64	.482	.42	1.32	.044	.43	.24	*	*

PERCENT OF BASELINE

	59.2	81.9	54.3	126.8	143	23.9	84.4	41.1	15.5	*****	*****
STD%	2.1	2.2	3.6	9.2	25	233.3	6.5	4.8	6.9	*****	*****



TABLE 16 SOLAR CELL I-V DATA (Cont.)

80109 W\*103TI001 (1.7E14) LOW RESISTIVITY W058 00 000  
 \*SOL7 1 /14/80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.551	20.20	-6.314	1.97	-.42	.721	9.45	.00	.00	.00
1B*	20.30	.487	16.13	-4.088	3.39	.19	.562	5.87	.52	.00	.00
2B	20.50	.575	17.72	-4.905	2.99	-2.10	.687	8.57	1.30	.00	.00
3B*	20.40	.532	17.09	-4.857	2.81	.66	.611	7.01	.65	.00	.00
4B	20.70	.570	17.56	-4.659	3.20	-1.47	.653	8.15	.78	.00	.00
5B	20.30	.582	17.62	-4.950	2.98	-2.43	.698	8.72	1.17	.00	.00
1C	11.50	.489	8.80	-3.771	4.42	-3.03	.546	3.25	.65	.00	.00
2C	11.60	.471	8.86	-3.771	4.27	-2.70	.543	3.14	.52	.00	.00
3C	11.70	.508	9.62	-4.285	3.60	-4.57	.631	3.97	.91	.00	.00
4C	11.60	.467	9.32	-4.313	3.28	-1.09	.582	3.34	.52	.00	.00
5C	11.70	.457	9.19	-4.100	3.52	-1.03	.560	3.17	.65	.00	.00
6C	11.80	.520	10.30	-5.467	2.45	-2.50	.695	4.51	1.30	.00	.00
7C	11.90	.502	9.74	-4.304	3.52	-3.40	.618	3.90	.91	.00	.00
8C	11.50	.482	8.83	-3.701	4.55	-4.61	.557	3.27	.91	.00	.00
9C	11.80	.504	9.49	-3.975	4.11	-5.67	.612	3.85	.91	.00	.00
10C	11.80	.491	9.53	-4.247	3.53	-2.48	.597	3.66	.65	.00	.00
11C	11.60	.482	9.28	-4.185	3.58	-2.12	.584	3.45	.65	.00	.00
12C	11.80	.525	10.80	-7.642	1.53	-.10	.746	4.88	1.56	.00	.00
1S	11.60	.498	9.53	-4.422	3.34	-2.72	.617	3.77	.78	.00	.00
2S	11.70	.520	10.31	-5.801	2.24	-1.76	.701	4.51	1.04	.00	.00
3S	11.70	.521	10.17	-5.334	2.56	-2.83	.692	4.46	1.04	.00	.00
4S	11.40	.507	9.57	-4.665	3.11	-3.36	.648	3.96	.91	.00	.00
5S	11.70	.523	10.58	-6.862	1.77	-.99	.735	4.76	1.17	.00	.00
1T	11.50	.515	9.84	-4.973	2.83	-3.21	.671	4.20	1.17	.00	.00
2T	11.20	.502	9.32	-4.554	3.22	-3.40	.637	3.79	.91	.00	.00
3T	11.70	.525	10.77	-8.276	1.38	.77	.746	4.85	1.69	.00	.00
4T	11.70	.501	9.57	-4.278	3.56	-3.87	.621	3.85	.91	.00	.00
5T	11.30	.519	10.00	-6.328	1.98	.57	.685	4.25	1.43	.00	.00
6T	11.80	.515	10.09	-4.978	2.82	-2.89	.668	4.29	1.04	.00	.00
AVERAGES: 80109 BASELINE W058 00 000											
	20.50	.576	17.63	-4.838	3.06	-2.00	.679	8.48	1.08	.00	.00
STD	.16	.005	.07	.128	.10	.40	.019	.24	.22	*	*
80109 W*103TI001 (1.7E14) LOW RESISTIVITY											
	11.63	.502	9.72	-4.967	3.10	-2.48	.639	3.96	.97	.00	.00
STD	.17	.019	.57	1.221	.87	1.58	.061	.53	.31	*	*
PERCENT OF BASELINE											
	56.8	87.2	55.1	97.3	101	76.4	94.0	46.7	89.2	*****	*****
STD%	1.3	4.1	3.5	28.6	33	119.0	11.9	7.8	52.2	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80110 W104CU-TI003 (2E15-1.4E14) W097 00 000

\*SOL7 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.552	20.15	-6.231	2.01	-.36	.716	9.40	.00	.00	.00
1B.*	23.20	.546	20.51	-5.629	2.28	-.85	.705	9.45	3.90	.00	.00
2B	23.30	.551	21.30	-7.293	1.63	-.04	.743	10.09	5.20	.00	.00
3B	23.00	.552	21.10	-7.473	1.58	-.16	.753	10.11	4.94	.00	.00
4B*	22.70	.542	19.48	-4.672	2.99	-2.07	.682	8.87	2.99	.00	.00
5B*	23.10	.547	19.65	-4.777	2.91	-.68	.648	8.66	3.51	.00	.00
1C	14.50	.472	12.48	-5.310	2.27	-.38	.657	4.76	1.04	.00	.00
2C	14.60	.473	12.73	-5.639	2.08	-.19	.672	4.91	1.04	.00	.00
3C	14.70	.470	12.64	-5.229	2.31	-.67	.659	4.82	.78	.00	.00
4C	14.50	.471	12.73	-5.876	1.95	.01	.679	4.91	1.17	.00	.00
5C	14.70	.471	12.86	-5.773	2.00	.00	.674	4.94	1.04	.00	.00
6C	14.50	.469	12.64	-5.593	2.09	-.39	.674	4.85	.91	.00	.00
7C	14.70	.475	12.81	-5.614	2.10	-.28	.673	4.97	1.04	.00	.00
8C	14.50	.471	12.67	-5.729	2.02	-.10	.674	4.87	1.04	.00	.00
9C	14.90	.473	12.91	-5.441	2.19	-.39	.666	4.96	.91	.00	.00
10C	14.70	.469	12.79	-5.603	2.08	-.12	.668	4.87	.91	.00	.00
11C	14.70	.470	12.73	-5.402	2.20	-.57	.668	4.88	1.04	.00	.00
1S	14.70	.474	12.84	-5.739	2.03	.02	.672	4.95	1.30	.00	.00
2S	14.60	.469	12.71	-5.572	2.10	-.35	.672	4.87	1.04	.00	.00
3S	14.30	.471	12.46	-5.636	2.07	-.18	.671	4.78	1.04	.00	.00
4S	14.40	.469	12.54	-5.645	2.06	-.06	.669	4.78	1.04	.00	.00
5S	14.80	.471	12.85	-5.499	2.14	-.34	.668	4.92	1.17	.00	.00
6S	14.60	.468	12.68	-5.480	2.14	-.49	.670	4.84	1.04	.00	.00
1T	14.10	.467	12.38	-5.979	1.89	.44	.674	4.69	.91	.00	.00
2T	14.60	.466	12.55	-5.248	2.28	-.55	.658	4.73	.91	.00	.00
3T	14.20	.466	12.36	-5.595	2.08	-.26	.670	4.69	1.04	.00	.00
4T	14.80	.469	12.84	-5.483	2.14	-.34	.667	4.90	.91	.00	.00
5T	15.20	.472	13.11	-5.243	2.30	-.82	.655	5.05	1.17	.00	.00
6T	14.40	.465	12.50	-5.504	2.12	-.35	.668	4.73	.91	.00	.00

AVERAGES: 80110 BASELINE W097 00 000

23.15 .552 21.20 -7.383 1.60 -.10 .748 10.10 5.07 .00 .00

STD .15 .000 .10 .090 .02 .06 .005 .01 .13 \* \*

80110 W104CU-TI003 (2E15-1.4E14)

14.60 .470 12.69 -5.558 2.11 -.28 .669 4.85 1.02 .00 .00

STD .23 .003 .18 .191 .11 .26 .005 .09 .11 \* \*

PERCENT OF BASELINE

63.0 85.2 59.8 124.7 132 -74.2 89.4 48.1 20.1 \*\*\*\*\* \*\*\*\*\*

STD% 1.4 .5 1.1 3.5 9 568.9 1.3 .9 2.8 \*\*\*\*\* \*\*\*\*\*

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80113 W105V001 (4E14) W057 00 000  
 SOL7 1 / 25 / 78 AMI: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	EFF	OOD	PCDa	PCDb
1A*	22.50	.552	20.12	-6.128	2.06	-1.52	.716	9.41	.00	.00	.00
1B	21.80	.589	19.58	-5.996	2.27	-1.72	.744	10.10	2.47	.00	.00
2B	21.40	.581	19.02	-5.735	2.39	1.36	.720	9.47	1.56	.00	.00
3B	21.60	.580	19.40	-6.202	2.14	-.93	.730	9.67	1.69	.00	.00
4B*	21.60	.581	18.74	-4.931	2.97	-2.16	.695	9.22	.91	.00	.00
5B	21.90	.586	19.65	-6.085	2.71	-1.18	.732	9.94	1.56	.00	.00
6B*	21.60	.568	18.45	-4.754	3.07	-1.44	.663	8.60	.91	.00	.00
1C	14.20	.480	11.00	-3.902	3.90	-.88	.547	3.94	.39	.00	.00
2C	14.10	.541	12.45	-5.743	2.32	-1.71	.706	5.70	1.04	.00	.00
3C	14.00	.468	10.99	-4.073	3.52	-.27	.554	3.84	.52	.00	.00
4C	14.20	.526	11.20	-3.698	4.73	-5.54	.595	4.70	.91	.00	.00
5C	13.90	.543	12.36	-6.080	2.15	-1.13	.711	5.68	1.04	.00	.00
6C	14.20	.545	12.61	-5.950	2.22	-1.56	.714	5.85	.91	.00	.00
7C	14.30	.549	13.11	-7.632	1.58	-.35	.753	6.26	1.56	.00	.00
8C	14.30	.546	13.05	-7.373	1.65	-.31	.745	6.15	1.30	.00	.00
9C	14.40	.525	12.17	-4.768	3.00	-1.92	.649	5.18	.91	.00	.00
10C	14.50	.525	12.13	-4.595	3.18	-1.99	.636	5.12	.78	.00	.00
11C	14.20	.502	11.56	-4.368	3.33	-.92	.595	4.49	.65	.00	.00
1S	14.30	.538	12.28	-5.013	2.84	-2.93	.677	5.47	1.04	.00	.00
2S	14.50	.541	12.60	-5.314	2.60	-1.83	.685	5.60	1.17	.00	.00
3S	14.50	.549	12.45	-4.841	3.05	-3.54	.685	5.76	1.17	.00	.00
4S	14.40	.544	12.80	-6.311	2.03	-.89	.718	5.95	1.17	.00	.00
5S	14.40	.552	13.44	-9.234	1.75	-.43	.775	6.52	1.30	.00	.00
6S	14.50	.547	13.20	-7.189	1.71	-.48	.743	6.23	1.56	.00	.00
1T	14.30	.534	12.11	-4.724	3.10	-2.63	.658	5.31	.91	.00	.00
2T	14.30	.492	11.60	-4.394	3.22	-.29	.586	4.36	.52	.00	.00
3T	14.10	.403	10.70	-3.941	3.21	.97	.515	3.10	.65	.00	.00
4T	14.20	.525	11.76	-4.347	3.51	-3.24	.635	5.01	.91	.00	.00
5T	14.20	.525	12.22	-5.192	2.62	-1.26	.666	5.25	.91	.00	.00
6T	14.30	.548	13.15	-7.915	1.51	-.02	.754	6.25	1.30	.00	.00
AVERAGES: 80113 BASELINE W057 00 000											
	21.68	.584	19.41	-6.005	2.25	-1.30	.731	9.79	1.82	.00	.00
STD	.19	.004	.24	.172	.09	.29	.009	.24	.38	*	*
80113 W105V001 (4E14)											
	14.27	.524	12.22	-5.504	2.71	-1.37	.665	5.29	.00	.00	.00
STD	.16	.034	.75	1.457	.85	1.41	.071	.86	.31	*	*
PERCENT OF BASELINE											
	65.9	89.7	52.9	108.3	120	94.0	90.9	54.1	54.0	*****	*****
STD%	1.3	6.5	4.7	27.6	44	156.4	10.9	10.4	31.6	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80116 W106N-AL002 (1E16) W079 00 C00

\*SOL7 1 / 8 / 80 AMI: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.553	20.24	-6.443	1.93	-.27	.721	9.49	.00	.70	.00
1B	22.10	.558	20.24	-7.353	1.64	-.22	.750	9.79	9.75	.00	.00
2B.*	21.60	.552	18.90	-5.250	2.57	-1.45	.698	8.80	4.16	.00	.00
3B	22.00	.561	20.45	-8.602	1.35	.12	.771	10.07	11.05	.00	.00
4B.*	22.00	.547	19.22	-5.102	2.65	-1.86	.703	8.95	5.85	.00	.00
1C	22.00	.551	20.04	-6.940	1.74	-.52	.747	9.58	8.45	.00	.00
2C.*	21.70	.539	18.32	-4.244	3.49	-3.30	.675	8.35	5.20	.00	.00
3C	21.60	.548	19.45	-6.262	1.99	-1.03	.737	9.23	6.50	.00	.00
4C	21.70	.549	19.39	-5.645	2.19	-1.47	.732	9.22	7.80	.00	.00
5C	22.20	.547	19.45	-5.163	2.60	-1.88	.708	9.10	8.06	.00	.00
6C	22.20	.538	18.96	-4.577	3.07	-2.20	.676	8.54	5.20	.00	.00
7C	21.90	.541	18.72	-4.479	3.20	-2.95	.688	8.62	6.50	.00	.00
8C	21.90	.550	19.70	-6.192	2.03	-1.06	.736	9.37	9.78	.00	.00
9C	21.80	.550	19.93	-7.215	1.65	-.34	.750	9.51	11.70	.00	.00
10C	22.00	.544	18.98	-4.735	2.95	-2.39	.693	8.77	6.50	.00	.00
11C	22.10	.546	20.22	-7.249	1.63	-.34	.751	9.59	10.80	.00	.00
1S	22.10	.547	19.93	-6.402	1.92	-.72	.734	9.38	8.45	.00	.00
2S	22.20	.541	19.98	-6.372	1.92	-.54	.727	9.24	8.84	.00	.00
3S.*	21.90	.536	18.36	-4.145	3.60	-3.27	.666	8.26	6.50	.00	.00
4S	22.00	.545	19.88	-6.508	1.88	-.66	.736	9.33	9.75	.00	.00
1T	22.30	.548	20.04	-6.222	2.00	-.81	.730	9.43	8.45	.00	.00
2T	21.90	.549	19.77	-6.437	1.92	-.78	.737	9.37	9.75	.00	.00
3T	21.70	.543	19.23	-5.591	2.31	-1.44	.718	8.95	7.80	.00	.00
AVERAGES: 80116 BASELINE W079 00 000											
	22.05	.560	20.34	-7.977	1.49	-.05	.761	9.93	10.40	.00	.00
STD	.05	.002	.11	.625	.14	.17	.010	.14	.65	*	*
80116 W106N-AL002 (1E16)											
	21.98	.546	19.60	-6.012	2.19	-1.20	.725	9.20	8.40	.00	.00
STD	.20	.004	.44	.853	.49	.76	.022	.31	1.66	*	*
PERCENT OF BASELINE											
	99.7	97.6	96.4	124.6	147	*****	95.3	92.7	80.7	*****	*****
STD%	1.1	.9	2.7	17.4	50	*****	4.2	4.5	22.0	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80202 REPEAT RUN OF W107FZ-AL001 (3E16) W101FZ001  
 \*SOL6 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	UCD	PCDa	PCDb
1R*	22.50	.551	20.29	-6.560	1.87	-.23	.725	9.50	.00	.00	.00
2CZB.*	22.20	.540	19.43	-5.188	2.55	-1.65	.703	8.92	3.64	.00	.00
3CZB.*	22.30	.545	20.41	-7.363	1.59	-.09	.746	9.59	4.55	.00	.00
1FZB.*	22.50	.543	19.86	-5.512	2.35	-1.20	.709	9.16	4.29	.00	.00
2FZB	22.70	.544	20.29	-5.991	2.09	-.85	.722	9.43	4.29	.00	.00
3FZB.*	22.50	.544	19.98	-5.677	2.26	-1.23	.719	9.30	4.29	.00	.00
4FZB.*	22.60	.539	19.57	-4.9 8	2.73	-1.63	.688	8.86	3.64	.00	.00
1C	21.90	.560	19.24	-5.300	2.57	-1.68	.708	9.19	2.60	.00	.00
2C	22.30	.573	20.18	-6.578	1.94	-.69	.739	9.99	3.25	.00	.00
3C	22.30	.566	19.79	-5.641	2.37	-1.39	.719	9.60	3.25	.00	.00
4C	22.20	.572	20.08	-6.511	1.97	-.77	.739	9.93	3.38	.00	.00
5C	22.40	.575	20.39	-6.875	1.84	-.60	.747	10.18	3.77	.00	.00
6C	22.30	.560	19.50	-5.226	2.62	-1.40	.697	9.20	2.47	.00	.00
7C	22.50	.572	20.43	-6.783	1.86	-.48	.740	10.07	3.64	.00	.00
8C	22.10	.564	19.07	-4.757	3.04	-2.38	.692	9.12	1.95	.00	.00
9C	22.30	.567	20.26	-6.747	1.86	-.73	.747	9.99	1.95	.00	.00
10C	22.20	.559	19.23	-4.923	2.86	-1.84	.690	9.05	2.86	.00	.00
11C	22.20	.567	19.94	-6.191	2.09	-.87	.729	9.71	1.30	.00	.00
12C	22.30	.555	18.63	-4.194	3.65	-2.59	.651	8.52	1.30	.00	.00
13C	22.60	.567	20.33	-6.252	2.06	-.88	.733	9.94	3.90	.00	.00
14C	22.30	.563	19.55	-5.205	2.65	-1.79	.707	9.39	2.21	.00	.00
15C	22.40	.556	19.40	-4.928	2.83	-1.77	.689	9.07	2.21	.00	.00
AVERAGES: 80202 BASELINE W101FZ001											
	22.70	.544	20.29	-5.991	2.09	-.85	.722	9.43	4.29	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
80202 REPEAT RUN OF W107FZ-AL001											
	22.29	.565	19.73	-5.741	2.41	-1.32	.715	9.53	2.67	.00	.00
STD	.16	.006	.53	.840	.52	.64	.027	.47	.82	*	*
PERCENT OF BASELINE											
	98.2	****	97.3	104.2	115	54.4	99.1	101.1	62.2	*****	*****
STD%	.7	1.1	2.6	14.0	25	75.7	3.7	5.0	19.2	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80222 W108N/V002 (8E13) W079 00 000

\*SOL8 1 / 8 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.552	20.21	-6.386	1.95	-.24	.718	9.43	.00	.00	.00
1B	20.90	.550	18.89	-6.599	1.87	-.55	.734	8.92	6.89	.00	.00
2B.*	21.20	.545	18.62	-5.374	2.46	-1.38	.703	8.59	4.55	.00	.00
3B	21.00	.547	18.83	-6.126	2.05	-.98	.728	8.85	4.55	.00	.00
4B	21.50	.552	19.51	-6.943	1.75	-.05	.731	9.18	7.80	.00	.00
5B.*	20.90	.546	18.69	-6.014	2.10	-1.05	.725	8.75	5.85	.00	.00
1C	18.30	.523	16.37	-6.219	1.95	-.65	.718	7.26	1.95	.00	.00
2C	18.00	.522	16.01	-5.985	2.06	-.80	.711	7.06	1.43	.00	.00
3C	18.30	.523	16.27	-5.925	2.09	-.97	.713	7.22	1.04	.00	.00
4C	18.20	.522	16.21	-6.000	2.05	-.92	.715	7.19	1.30	.00	.00
5C	18.10	.524	16.33	-6.579	1.81	-.57	.730	7.32	1.56	.00	.00
6C	18.40	.525	16.52	-6.220	1.96	-1.11	.731	7.47	1.69	.00	.00
7C	18.10	.515	15.95	-5.773	2.13	-.44	.691	6.81	1.56	.00	.00
8C	17.80	.517	15.66	-5.639	2.22	-.89	.695	6.77	1.82	.00	.00
9C	18.20	.519	16.13	-5.885	2.09	-.70	.704	7.03	1.56	.00	.00
10C	18.90	.528	17.17	-6.892	1.71	-.53	.741	7.82	1.95	.00	.00
11C	18.60	.519	16.12	-5.227	2.48	-.89	.674	6.88	1.56	.00	.00
12C	18.30	.520	16.39	-6.273	1.92	-.57	.718	7.22	2.47	.00	.00
1S	19.00	.527	17.26	-6.842	1.72	-.68	.745	7.88	1.95	.00	.00
2S	19.00	.527	17.26	-6.842	1.72	-.68	.745	7.88	1.56	.00	.00
3S	18.50	.519	16.22	-5.534	2.28	-.82	.690	7.00	.65	.00	.00
4S	18.40	.520	16.37	-6.101	1.99	-.37	.705	7.13	1.30	.00	.00
5S	18.50	.520	16.33	-5.697	2.19	-.95	.702	7.14	1.30	.00	.00
1T	17.90	.527	16.32	-7.225	1.61	-.17	.741	7.39	1.56	.00	.00
2T	17.80	.522	15.76	-5.827	2.14	-.85	.704	6.92	1.95	.00	.00
3T	17.80	.520	15.85	-6.149	1.97	-.37	.706	6.91	1.56	.00	.00
4T	17.90	.518	16.05	-6.562	1.80	-.19	.708	6.94	2.08	.00	.00
5T	17.90	.517	15.67	-5.493	2.31	-.95	.689	6.75	1.95	.00	.00
AVERAGES: 80222 BASELINE W079 00 000											
	21.13	.550	19.08	-6.556	1.89	-.53	.731	8.98	6.41	.00	.00
STD	.26	.002	.31	.335	.13	.38	.002	.14	1.37	*	*
80222 W108N/V002 (8E13)											
	18.27	.522	16.28	-6.131	2.01	-.67	.712	7.18	1.63	.00	.00
STD	.36	.004	.44	.504	.22	.30	.019	.33	.38	*	*
PERCENT OF BASELINE											
	86.4	94.9	85.4	106.5	106	73.2	97.4	80.0	25.3	*****	*****
STD%	2.8	1.0	3.7	12.9	19	186.9	3.0	5.0	12.6	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80220 W109C-002 (1.4E17) W097 00 000

\*SOL8 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCF	PCDa	PCDb
1R*	22.50	.552	20.15	-6.231	2.01	-.36	.716	9.40	.00	.00	.00
1B*	22.70	.538	18.52	-3.768	4.22	-3.65	.637	8.22	2.08	.00	.00
2B.*	22.90	.544	19.57	-4.547	3.13	-2.30	.679	8.95	3.12	.00	.00
3B	22.90	.548	20.59	-6.267	1.98	-.72	.730	9.68	4.94	.00	.00
4B	22.60	.548	20.38	-6.381	1.93	-.72	.734	9.61	5.20	.00	.00
5B*	22.80	.538	18.71	-3.875	4.02	-3.21	.638	8.28	2.21	.00	.00
1C	22.20	.548	19.40	-5.014	2.72	-2.32	.712	9.16	4.16	.00	.00
2C	22.10	.543	19.24	-4.955	2.75	-2.21	.704	8.94	2.86	.00	.00
3C	22.10	.542	19.65	-5.765	2.20	-1.14	.719	9.11	4.42	.00	.00
4C	22.40	.544	19.79	-5.509	2.35	-1.32	.712	9.18	4.55	.00	.00
5C	22.30	.542	19.53	-5.144	2.59	-1.88	.708	9.05	4.42	.00	.00
6C	21.90	.543	19.63	-6.050	2.07	-1.07	.730	9.18	4.42	.00	.00
7C	22.10	.541	19.79	-6.063	2.05	-.90	.726	9.18	4.29	.00	.00
8C	22.50	.540	19.80	-5.366	2.43	-1.42	.708	9.10	3.25	.00	.00
9C.*	21.70	.540	18.56	-4.434	3.26	-3.36	.695	8.61	3.64	.00	.00
10C	22.80	.543	19.76	-4.903	2.78	-1.84	.692	9.06	3.90	.00	.00
1S	22.10	.547	19.59	-5.626	2.30	-1.26	.716	9.15	4.16	.00	.00
2S	22.30	.547	19.90	-5.967	2.12	-.83	.719	9.28	5.85	.00	.00
4S	22.20	.544	19.47	-5.271	2.51	-1.50	.704	8.99	3.90	.00	.00
5S	22.00	.544	19.83	-6.447	1.90	-.50	.728	9.22	4.94	.00	.00
6S	22.00	.546	19.75	-6.169	2.02	-.88	.729	9.26	4.55	.00	.00
1T	22.70	.547	20.00	-5.609	2.30	-.59	.694	9.12	4.16	.00	.00
2T	22.30	.546	19.90	-5.959	2.12	-.83	.719	9.26	4.94	.00	.00
3T	21.90	.541	19.24	-5.367	2.44	-1.35	.704	8.82	4.42	.00	.00
4T	22.40	.543	19.84	-5.630	2.28	-1.11	.712	9.16	4.03	.00	.00
5T	22.30	.543	19.89	-5.911	2.13	-.92	.720	9.22	4.94	.00	.00
AVERAGES: 80220 BASELINE W097 00 000											
	22.75	.548	20.49	-6.324	1.96	-.72	.732	9.65	5.07	.00	.00
STD	.15	.000	.11	.057	.02	.00	.002	.04	.13	*	*
80220 W109C-002 (1.4E17)											
	22.24	.544	19.68	-5.617	2.32	-1.26	.713	9.13	4.32	.00	.00
STD	.24	.002	.21	.430	.26	.50	.011	.11	.63	*	*
PERCENT OF BASELINE											
	97.8	99.3	96.1	111.2	119	24.8	97.5	94.6	85.3	*****	*****
STD%	1.7	.4	1.6	7.7	15	69.7	1.8	1.5	14.8	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80224 W\*110FE001 LOW RESISTIVITY (8E14) W058 00 000  
 \*SOLE 1 /14/80 AMI: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.555	20.00	-5.844	2.21	-.74	.710	9.38	.00	.00	.00
1B*	19.30	.552	15.76	-4.118	3.83	-1.94	.612	6.89	.52	.00	.00
2B*	19.50	.570	15.78	-3.786	4.58	-4.18	.623	7.32	.65	.00	.00
3F	20.10	.588	18.01	-6.057	2.25	-1.41	.733	9.16	1.56	.00	.00
4B*	19.30	.467	14.94	-3.920	3.53	.51	.535	5.10	.52	.00	.00
1C	18.30	.580	15.23	-4.008	4.26	-5.53	.669	7.51	.91	.00	.00
2C	18.30	.572	14.60	-3.454	5.54	-7.76	.635	7.03	.91	.00	.00
3C	18.40	.570	15.78	-4.797	3.11	-2.37	.677	7.51	.91	.00	.00
4C	18.30	.577	15.98	-5.199	2.78	-2.26	.702	7.83	1.04	.00	.00
5C	18.30	.584	16.24	-5.654	2.49	-2.07	.724	8.18	1.17	.00	.00
6C	18.30	.573	15.18	-4.112	4.03	-3.99	.649	7.20	.91	.00	.00
7C	18.10	.568	15.42	-4.641	3.27	-2.72	.671	7.30	.91	.00	.00
8C	18.40	.585	16.47	-5.983	2.30	-1.83	.735	8.36	1.30	.00	.00
9C	18.50	.583	16.21	-5.190	2.82	-2.71	.712	8.12	1.04	.00	.00
10C	18.10	.574	15.22	-4.339	3.69	-3.63	.663	7.29	.65	.00	.00
11C	18.20	.574	16.42	-6.358	2.11	-1.49	.743	8.35	1.30	.00	.00
1S	18.50	.583	16.65	-6.367	2.10	-1.07	.733	8.37	1.30	.00	.00
2S	18.60	.581	16.47	-5.642	2.48	-1.72	.716	8.18	1.17	.00	.00
3S	18.50	.566	15.16	-3.962	4.24	-4.04	.635	7.03	.91	.00	.00
4S*	18.50	.553	15.03	-4.048	3.99	-2.31	.609	6.59	.39	.00	.00
1T*	17.10	.503	13.11	-3.990	3.78	1.42	.521	4.74	.52	.00	.00
2T	17.70	.582	16.24	-7.501	1.69	-.56	.759	8.27	1.56	.00	.00
3T	17.80	.560	14.60	-4.103	3.97	-3.04	.626	6.60	.65	.00	.00
4T	18.10	.580	15.98	-5.579	2.53	-1.78	.712	7.90	1.30	.00	.00
AVERAGES: 80224 BASELINE W058 00 000											
	20.10	.588	18.01	-6.057	2.25	-1.41	.733	9.16	1.56	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
80224 W*110FE001 LOW RESISTIVITY (8E14)											
	18.26	.577	15.76	-5.111	3.14	-2.86	.692	7.71	1.06	.00	.00
STD	.24	.007	.64	1.047	.98	1.71	.040	.55	.24	*	*
PERCENT OF BASELINE											
	90.8	98.1	87.5	115.6	139	-3.3	94.4	84.2	67.6	*****	*****
STD	1.2	1.2	3.6	17.3	44	121.6	5.5	6.0	15.4	*****	*****



TABLE 16 SCLAR CELL I-V DATA (Cont.)

80227 W111CU-V001 (2.5E15-3E14) W097 00 000

\*SOL8 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.552	19.90	-5.666	2.29	-.84	.705	9.26	.00	.00	.00
1B.*	21.60	.542	18.55	-4.741	2.94	-1.96	.679	8.41	3.51	.00	.00
2B	21.70	.547	19.46	-6.159	2.03	-.83	.726	9.12	4.81	.00	.00
3B.*	21.30	.539	18.70	-5.361	2.44	-1.37	.702	8.53	3.90	.00	.00
4B.*	21.40	.540	18.60	-5.675	2.25	.87	.652	7.96	3.64	.00	.00
1C	15.00	.476	13.17	-5.965	1.92	.42	.674	5.09	.52	.00	.00
2C	15.60	.476	13.55	-5.546	2.13	-.06	.665	5.23	.52	.00	.00
3C	15.00	.474	12.98	-5.355	2.24	-.70	.669	5.03	.65	.00	.00
4C.*	14.20	.463	11.34	-3.871	3.81	-3.93	.601	4.18	.65	.00	.00
5C	15.30	.475	13.43	-5.832	1.98	-.05	.679	5.22	.65	.00	.00
6C	15.10	.469	12.97	-5.174	2.34	-.79	.660	4.94	.65	.00	.00
7C	15.20	.476	13.47	-6.141	1.84	-.03	.693	5.31	.78	.00	.00
8C	15.50	.476	13.71	-5.986	1.90	-.33	.694	5.42	.65	.00	.00
9C	15.40	.469	13.07	-4.920	2.52	-.87	.645	4.93	.39	.00	.00
10C	15.40	.474	13.35	-5.427	2.19	-.47	.668	5.16	.65	.00	.00
11C	15.60	.472	13.50	-5.377	2.21	-.48	.666	5.19	.78	.00	.00
12C	15.10	.476	13.39	-6.078	1.87	-.37	.699	5.31	.91	.00	.00
1S	15.60	.481	13.95	-6.393	1.75	-.27	.711	5.64	.91	.00	.00
2S	15.50	.477	13.71	-6.033	1.89	-.18	.693	5.42	.78	.00	.00
3S	15.40	.478	13.64	-6.031	1.89	-.36	.697	5.43	.91	.00	.00
4S	15.10	.478	13.47	-6.315	1.78	-.21	.706	5.39	.91	.00	.00
5S	15.40	.478	13.75	-6.391	1.74	-.05	.705	5.49	.91	.00	.00
1T	15.10	.474	12.88	-4.913	2.56	-1.52	.659	4.99	.91	.00	.00
2T.*	14.80	.462	10.82	-3.980	3.58	4.01	.469	3.39	.39	.00	.00
3T	15.20	.468	12.83	-4.746	2.67	-1.45	.645	4.85	.65	.00	.00
4T	14.90	.469	12.86	-5.257	2.28	-.90	.667	4.93	.65	.00	.00
5T	15.10	.469	13.02	-5.236	2.29	-.87	.666	4.99	.78	.00	.00

AVERAGES: 80227 BASELINE W097 00 000

	21.70	.547	19.46	-6.159	2.03	-.83	.726	9.12	4.81	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*

80227 W111CU-V001 (2.5E15-3E14)

	15.28	.474	13.34	-5.656	2.10	-.48	.678	5.20	.73	.00	.00
STD	.22	.004	.33	.509	.28	.47	.020	.22	.15	*	*

PERCENT OF BASELINE

	70.4	86.7	68.5	108.2	103	142.3	93.3	57.0	15.1	*****	*****
STD%	1.0	.7	1.7	8.3	14	57.0	2.7	2.4	3.1	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80522 W111CU/V001 (2.5E15/3E14) REPEAT RUN W097 00 000  
 \*SOL9 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.558	20.04	-7.143	1.70	-.67	.758	9.80	.00	.00	.00
1B	22.30	.549	20.04	-6.176	2.03	-.99	.734	9.50	4.16	.00	.00
2B	22.30	.551	20.34	-6.965	1.73	-.62	.752	9.77	4.42	.00	.00
3B.*	22.30	.544	19.84	-5.848	2.17	-.86	.715	9.17	3.64	.00	.00
4B.*	22.50	.548	19.84	-5.441	2.41	-1.33	.709	9.24	3.38	.00	.00
1C	15.60	.481	13.93	-6.369	1.76	-.09	.705	5.60	.91	.00	.00
2C	15.80	.480	14.03	-6.043	1.89	-.62	.705	5.66	.91	.00	.00
1S	15.70	.480	14.01	-6.337	1.77	-.16	.706	5.63	1.30	.00	.00
2S	15.70	.479	13.97	-6.163	1.84	-.44	.706	5.61	.91	.00	.00
3S	15.70	.474	13.09	-4.391	3.06	-2.56	.642	5.05	.65	.00	.00
1T	14.10	.467	12.74	-7.629	1.35	2.16	.691	4.81	.39	.00	.00
2T.*	15.00	.461	12.00	-3.923	3.66	-3.06	.598	4.37	.39	.00	.00
3T	15.60	.475	13.63	-5.587	2.10	-.59	.681	5.34	.78	.00	.00

AVERAGES: 80522 BASELINE W097 00 000

22.30 .550 20.19 -6.570 1.88 -.81 .743 9.63 4.29 .00 .00

STD .00 .001 .15 .394 .15 .19 .009 .13 .13 \* \*

80522 W111CU/V001 (2.5E15/3E14) REPEAT RUN

15.46 .477 13.63 -6.074 1.97 -.33 .691 5.38 .84 .00 .00

STD .56 .005 .48 .899 .49 1.28 .022 .31 .26 \* \*

PERCENT OF BASELINE

69.3 86.6 67.5 107.5 105 159.2 93.0 55.9 19.5 \*\*\*\*\* \*\*\*\*\*

STD% 2.5 1.0 2.9 20.1 36 204.7 4.1 4.0 6.8 \*\*\*\*\* \*\*\*\*\*

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80301 W112TA001 (8.3E11) W097 00 000  
 \*SOLE 1 / 3 / 80 AML: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.553	20.07	-6.052	2.10	-.46	.711	9.36	.00	.00	.00
1B.*	21.70	.536	17.94	-4.038	3.77	-2.87	.641	7.89	1.82	.00	.00
2B.*	22.00	.547	18.90	-4.588	3.12	-2.79	.692	8.81	3.64	.00	.00
3B.*	21.20	.541	16.75	-4.385	3.33	2.36	.535	6.49	2.99	.00	.00
4B	21.40	.544	19.21	-6.176	2.02	-.90	.729	8.97	3.90	.00	.00
5B	22.00	.548	19.92	-6.612	1.85	-.66	.740	9.43	4.42	.00	.00
1C	19.20	.525	16.31	-4.537	3.11	-2.58	.670	7.14	.91	.00	.00
2C	19.20	.528	16.97	-5.736	2.19	-.86	.703	7.53	.91	.00	.00
3C	19.60	.521	16.71	-4.815	2.80	-1.17	.657	7.09	.65	.00	.00
4C	19.60	.534	17.69	-6.734	1.77	-.05	.722	8.00	1.17	.00	.00
5C	19.40	.523	16.80	-5.113	2.57	-1.30	.680	7.30	.91	.00	.00
6C	19.20	.532	16.98	-5.692	2.24	-1.11	.707	7.64	1.04	.00	.00
8C	19.10	.528	16.23	-4.507	3.16	-2.84	.673	7.18	.91	.00	.00
9C	19.50	.533	17.61	-6.732	1.77	-.10	.724	7.96	1.04	.00	.00
10C	19.70	.529	17.45	-5.798	2.16	-.79	.705	7.77	.91	.00	.00
1S	19.10	.529	16.70	-5.287	2.48	-1.57	.697	7.45	1.04	.00	.00
2S	19.70	.529	17.35	-5.633	2.25	-.76	.696	7.67	.91	.00	.00
3S	18.80	.521	16.43	-5.445	2.34	-.81	.685	7.09	.65	.00	.00
4S	20.30	.534	18.20	-6.543	1.84	.30	.705	8.08	1.04	.00	.00
5S	19.90	.532	17.64	-5.875	2.13	-.57	.702	7.86	.91	.00	.00
6S	19.20	.534	17.24	-6.436	1.89	-.32	.719	7.79	1.04	.00	.00
1T	19.30	.527	16.54	-4.764	2.89	-2.08	.676	7.27	.78	.00	.00
2T	19.20	.525	16.65	-5.076	2.61	-1.68	.687	7.32	.65	.00	.00
3T	19.10	.528	16.91	-5.763	2.18	-.99	.708	7.55	.91	.00	.00
4T	19.50	.517	16.34	-4.352	3.27	-2.33	.649	6.92	.52	.00	.00
5T	19.60	.525	17.08	-5.198	2.51	-1.48	.691	7.52	.91	.00	.00
AVERAGES: 80301 BASELINE W097 00 000											
	21.70	.546	19.57	-6.394	1.93	-.78	.734	9.20	4.16	.00	.00
STD	.30	.002	.36	.218	.08	.12	.006	.23	.26	*	*
80301 W112TA001 (8.3E11)											
	19.41	.528	16.99	-5.502	2.41	-1.15	.693	7.51	.89	.00	.00
STD	.33	.005	.52	.712	.44	.83	.020	.33	.16	*	*
PERCENT OF BASELINE											
	89.4	96.6	86.8	114.0	125	51.8	94.3	81.6	21.4	*****	*****
STD%	2.8	1.2	4.3	14.4	29	145.2	3.5	5.7	5.4	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

805221 W113FZ/CROO1 (8E14) W101 00 000  
 \*SOL9 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.556	20.05	-7.171	1.69	-.71	.761	9.79	.00	.00	.00
1B	22.30	.549	20.22	-6.634	1.84	-.76	.745	9.64	3.90	.00	.00
2B	22.00	.548	19.94	-6.617	1.85	-.73	.742	9.47	3.90	.00	.00
3B	22.10	.548	19.82	-6.050	2.08	-1.17	.733	9.39	3.90	.00	.00
4B	22.60	.549	20.38	-6.324	1.96	-.90	.738	9.68	4.16	.00	.00
1C	20.00	.515	17.82	-5.945	2.03	-.88	.716	7.80	.91	.00	.00
2C	19.90	.515	17.77	-6.008	2.00	-.94	.721	7.81	1.04	.00	.00
3C	20.10	.515	18.02	-6.244	1.89	-.63	.722	7.90	1.04	.00	.00
1S	20.00	.511	17.08	-4.644	2.90	-2.19	.674	7.29	.91	.00	.00
2S	20.00	.514	17.73	-5.699	2.15	-1.22	.714	7.77	1.04	.00	.00
3S	20.20	.516	17.96	-5.781	2.11	-1.20	.718	7.92	1.04	.00	.00
4S	20.30	.515	18.13	-5.983	2.00	-1.01	.723	7.99	1.17	.00	.00
1T	20.00	.515	17.82	-5.900	2.05	-1.08	.720	7.84	.91	.00	.00
2T	20.00	.515	17.69	-5.646	2.18	-1.14	.709	7.73	.91	.00	.00
3T	20.20	.515	17.97	-5.957	2.02	-.64	.710	7.81	1.04	.00	.00
AVERAGES: 805221 BASELINE W101 00 000											
	22.25	.549	20.09	-6.406	1.93	-.89	.740	9.55	3.97	.00	.00
STD	.23	.000	.22	.240	.10	.17	.004	.12	.11	*	*
805221 W113FZ/CROO1 (8E14)											
	20.07	.515	17.80	-5.781	2.13	-1.09	.713	7.79	1.00	.00	.00
STD	.12	.001	.27	.412	.27	.42	.014	.18	.08	*	*
PERCENT OF BASELINE											
	90.2	93.8	88.6	109.8	110	77.2	96.4	81.6	25.2	*****	*****
STD%	1.5	.3	2.4	10.0	20	79.5	2.4	2.9	2.9	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80317 W115N/CU002 (1E16) W079 00 00C

\*SOL8 1 / 8 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.552	20.15	-6.261	2.00	-.27	.714	9.38	.00	.00	.00
1B*	20.20	.526	15.72	-3.292	5.46	-5.95	.600	6.74	.00	.00	.00
2B	20.60	.541	18.52	-6.317	1.95	-.72	.728	8.58	5.85	.00	.00
3B	21.00	.544	19.16	-7.134	1.67	-.31	.745	9.01	4.94	.00	.00
4B	21.20	.551	19.43	-7.315	1.63	-.48	.757	9.35	4.94	.00	.00
1C	21.50	.545	19.14	-5.938	2.13	-.70	.712	8.82	3.90	.00	.00
2C.*	20.70	.533	17.03	-3.859	4.09	-4.24	.650	7.59	1.43	.00	.00
3C	20.90	.534	17.71	-4.498	3.16	-2.17	.663	7.83	1.43	.00	.00
4C	21.30	.540	18.27	-4.706	2.97	-2.10	.679	8.26	2.34	.00	.00
5C	20.40	.537	17.92	-5.349	2.45	-1.62	.706	8.18	2.21	.00	.00
6C	20.80	.536	18.06	-5.027	2.68	-1.75	.691	8.15	2.21	.00	.00
7C	21.00	.535	18.00	-4.753	2.91	-1.82	.674	8.01	1.56	.00	.00
8C	20.70	.537	18.25	-5.554	2.32	-1.14	.705	8.28	2.60	.00	.00
9C	20.40	.540	17.91	-5.359	2.46	-1.49	.703	8.19	2.21	.00	.00
10C	20.20	.519	17.24	-4.873	2.73	-.91	.655	7.26	1.69	.00	.00
11C	20.90	.537	17.71	-4.435	3.25	-2.57	.668	7.93	1.30	.00	.00
1S	22.20	.555	19.29	-4.932	2.83	-2.12	.699	9.11	4.42	.00	.00
2S	20.60	.525	16.88	-4.101	3.63	-1.90	.617	7.06	.78	.00	.00
3S	20.80	.533	17.60	-4.475	3.19	-2.20	.661	7.75	1.30	.00	.00
4S	20.00	.537	17.63	-5.499	2.36	-1.46	.709	8.05	2.08	.00	.00
5S	21.70	.548	19.55	-6.429	1.92	-.53	.728	9.16	4.55	.00	.00
1T	20.80	.538	18.15	-5.197	2.56	-1.51	.695	8.22	1.95	.00	.00
2T	20.90	.537	18.10	-4.993	2.71	-1.62	.685	8.13	1.95	.00	.00
3T	21.00	.543	18.41	-5.292	2.51	-1.55	.702	8.47	2.34	.00	.00
4T	20.50	.539	18.05	-5.479	2.38	-1.34	.706	8.25	2.34	.00	.00
AVERAGES: 80317 BASELINE W079 00 000											
	20.93	.545	19.03	-6.922	1.75	-.50	.743	8.98	5.24	.00	.00
STD	.25	.004	.38	.434	.14	.17	.012	.32	.43	*	*
80317 W115N/CU002 (1E16)											
	20.87	.538	18.10	-5.099	2.69	-1.61	.687	8.16	2.27	.00	.00
STD	.51	.007	.64	.549	.41	.52	.025	.50	.99	*	*
PERCENT OF BASELINE											
	99.7	98.6	95.1	126.3	154	*****	92.5	90.9	43.3	*****	*****
STD%	3.7	2.1	5.3	13.0	38	245.8	4.9	9.0	23.9	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80321 W\*116PH001 (1E17) LOW RESISTIVITY RUN W057 00 000  
 \*SOL8 1 /14/80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	22.50	.556	20.03	-5.941	2.16	-.59	.710	9.39	.00	.00	.00
1B*	21.20	.577	17.26	-3.692	4.77	-5.04	.643	8.31	1.04	.00	.00
2B	21.40	.581	18.65	-5.084	2.84	-1.92	.698	9.18	1.69	.00	.00
3B	21.40	.577	18.79	-5.374	2.60	-1.37	.701	9.15	1.30	.00	.00
4B*	21.40	.568	17.89	-4.274	3.64	-2.41	.648	8.32	.91	.00	.00
5B	21.60	.568	18.83	-5.299	2.61	-.88	.683	8.87	1.04	.00	.00
1C	21.30	.565	17.77	-4.366	3.50	-1.63	.635	8.09	.91	.00	.00
2C	21.00	.584	18.57	-5.497	2.55	-1.81	.718	9.32	1.95	.00	.00
3C	21.30	.579	18.73	-5.425	2.58	-1.37	.703	9.17	1.56	.00	.00
4C*	21.40	.560	17.82	-4.392	3.43	-1.23	.628	7.96	.91	.00	.00
5C	21.30	.580	19.18	-6.315	2.09	-.93	.734	9.59	1.95	.00	.00
6C	21.40	.561	18.29	-4.899	2.90	-.78	.655	8.31	.91	.00	.00
7C*	20.90	.550	17.47	-4.707	3.03	.15	.615	7.4 <sup>R</sup>	.91	.00	.00
8C	21.10	.572	18.02	-4.707	3.15	-1.80	.667	8.5 <sub>1</sub>	1.30	.00	.00
9C*	21.00	.534	17.16	-4.312	3.39	-.25	.595	7.05	.52	.00	.00
10C*	21.00	.535	16.65	-4.163	3.59	.93	.552	6.56	.39	.00	.00
11C	21.30	.572	18.14	-4.653	3.20	-1.80	.664	8.55	1.04	.00	.00
12C	21.30	.576	18.55	-5.048	2.85	-2.06	.699	9.07	1.69	.00	.00
13C	21.30	.580	18.99	-5.934	2.27	-.96	.718	9.38	1.56	.00	.00
1S	20.30	.579	18.15	-6.080	2.20	-.92	.721	8.96	1.56	.00	.00
2S	20.70	.565	17.49	-4.537	3.31	-1.84	.653	8.08	.91	.00	.00
3S	20.80	.577	18.32	-5.475	2.54	-1.40	.706	8.96	1.30	.00	.00
4S	21.00	.582	19.18	-7.200	1.76	-.35	.748	9.67	2.08	.00	.00
5S	21.10	.583	19.05	-6.471	2.03	-.78	.735	9.56	1.95	.00	.00
1T*	21.30	.529	17.55	-4.538	3.08	.40	.596	7.10	.78	.00	.00
2T	21.10	.570	17.78	-4.384	3.51	-2.46	.658	8.36	1.30	.00	.00
3T*	21.00	.569	17.13	-3.841	4.39	-3.75	.631	7.98	1.04	.00	.00
4T	21.00	.575	18.16	-4.935	2.95	-1.91	.686	8.76	.91	.00	.00
5T	20.80	.563	17.86	-4.915	2.91	-1.27	.667	8.27	1.17	.00	.00
6T*	21.30	.551	17.85	-4.509	3.24	-1.09	.634	7.87	.91	.00	.00

AVERAGES: 80321 BASELINE W057 00 000

	21.47	.575	18.76	-5.253	2.68	-1.39	.694	9.06	1.34	.00	.00
STD	.09	.005	.08	.123	.11	.43	.008	.14	.27	*	*

80321 W\*116PH001 (1E17) LOW RESISTIVITY RUN

	21.06	.574	18.37	-5.344	2.72	-1.42	.692	8.86	1.41	.00	.00
STD	.28	.007	.51	.791	.51	.55	.033	.52	.40	*	*

PERCENT OF BASELINE

	98.1	99.8	97.9	98.3	101	98.4	99.7	97.7	105.3	*****	*****
STD%	1.7	2.2	3.1	17.8	24	82.2	5.9	7.4	56.5	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80404 W119N/FF002 (3E14) W079 00 000												
SOLAR 4/24/78 AM1: PO=91.60MM/CM12 NO AR COATING												
IL	ISC	VOC	IF	LOG(I0)	N	B	FF	FFP	OC0	PC0A	PC0B	
14*	22.50	.552	20.21	-6.386	1.95	-.24	.718	9.49	.00	.00	.00	
15*	22.30	.547	18.83	-4.459	3.25	-1.83	.655	8.45	3.12	.00	.00	
20	22.00	.561	19.74	-6.144	2.09	-.95	.729	9.52	5.85	.00	.00	
25*	22.20	.549	18.65	-4.305	3.46	-2.35	.655	8.44	3.25	.00	.00	
30*	22.20	.513	17.85	-4.086	3.52	-.37	.580	6.08	.01	.00	.00	
35*	21.90	.547	19.17	-5.257	2.54	-1.42	.600	8.85	4.04	.00	.00	
40	21.40	.536	17.73	-4.102	3.67	-2.60	.640	7.76	1.95	.00	.00	
45	21.30	.525	17.32	-3.900	3.93	-2.64	.618	7.31	1.17	.00	.00	
50	21.20	.536	17.26	-4.451	3.22	-2.38	.666	8.00	1.69	.00	.00	
55	21.20	.528	17.49	-4.003	3.64	-2.40	.623	7.49	1.04	.00	.00	
60	21.00	.544	18.24	-4.956	2.77	-2.12	.697	8.42	2.72	.00	.00	
65	21.30	.531	17.41	-4.277	3.40	-2.27	.649	7.75	1.56	.00	.00	
70*	21.10	.516	16.87	-3.320	5.21	-7.16	.649	7.48	1.57	.00	.00	
75	21.50	.525	17.57	-4.028	3.71	-2.00	.617	7.36	.73	.00	.00	
80	21.40	.534	18.11	-4.491	3.16	-2.00	.660	7.98	1.95	.00	.00	
90	21.50	.532	17.97	-4.245	3.45	-2.38	.649	7.85	1.92	.00	.00	
100	21.50	.546	19.06	-5.708	2.26	-1.06	.712	8.84	3.25	.00	.00	
110	20.90	.527	17.20	-4.041	3.73	-2.63	.632	7.36	.91	.00	.00	
120	21.20	.524	17.41	-4.094	3.61	-1.99	.622	7.31	.91	.00	.00	
130	21.60	.547	18.94	-5.294	2.52	-1.47	.702	8.77	3.90	.00	.00	
140	21.40	.540	18.26	-4.571	3.11	-2.32	.675	8.25	2.34	.00	.00	
150	21.60	.531	17.91	-4.126	3.60	-2.49	.620	7.77	1.69	.00	.00	
160	21.40	.534	17.85	-4.208	3.51	-2.50	.648	7.83	1.62	.00	.00	
170	21.40	.535	17.97	-4.316	3.38	-2.37	.654	7.92	1.95	.00	.00	
180	21.10	.520	16.99	-3.894	3.91	-1.97	.599	6.96	1.04	.00	.00	
190*	18.50	.516	14.91	-3.738	4.29	-4.37	.622	6.28	.79	.00	.00	
200	18.60	.527	16.45	-5.725	2.20	-1.03	.705	7.31	.91	.00	.00	
210	18.60	.515	15.61	-4.429	3.19	-2.19	.648	6.57	.32	.00	.00	
220	18.50	.427	14.29	-4.105	3.00	1.60	.522	4.36	.65	.00	.00	
230	18.70	.507	15.43	-4.259	3.34	-1.76	.623	6.24	.65	.00	.00	
AVERAGES: 80404 BASELINE W079 00 000												
	22.00	.561	19.74	-6.144	2.09	-.95	.729	9.52	5.85	.00	.00	
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*	
80404 W119N/FF002 DOUBLE METALIZATION												
	20.83	.526	17.43	-4.424	3.29	-1.95	.646	7.52	1.59	.00	.00	
STD	1.07	.024	1.10	.518	.48	.89	.040	.92	.86	*	*	
EFFICIENCY OF BASELINE												
	94.7	93.8	88.3	128.0	157	-6.5	88.5	79.0	27.2	*****	*****	
STD	4.8	4.2	5.6	8.4	23	94.4	5.5	9.7	14.8	*****	*****	

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80405 W120N/CRO02 (3E14) W079 00 000

\*SOL8 1 / 8 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCDb
1R*	22.50	.552	20.18	-6.307	1.98	-.30	.717	9.42	.00	.00
1B	21.70	.549	19.57	-6.510	1.89	-.41	.728	9.17	5.20	.00 .00
2B.*	21.70	.531	18.11	-4.306	3.35	-1.81	.639	7.79	1.82	.00 .00
3B	21.60	.548	19.96	-8.212	1.40	.32	.755	9.45	7.28	.00 .00
4B	21.30	.541	19.10	-6.442	1.89	.01	.711	8.66	4.94	.00 .00
1C.*	20.40	.546	17.37	-4.448	3.31	-3.20	.683	8.04	1.95	.00 .00
2C	21.00	.555	18.62	-5.567	2.38	-1.73	.723	8.91	3.90	.00 .00
3C	20.70	.547	18.28	-5.577	2.35	-1.23	.708	8.48	2.60	.00 .00
4C	21.50	.548	19.01	-5.698	2.27	-.81	.704	8.77	4.16	.00 .00
5C	21.70	.564	20.12	-8.301	1.42	-.05	.770	9.96	9.10	.00 .00
6C	21.90	.556	19.97	-7.093	1.71	-.28	.744	9.58	6.50	.00 .00
7C	21.40	.563	19.18	-6.078	2.13	-1.06	.729	9.28	5.20	.00 .00
8C	21.00	.548	17.89	-4.535	3.20	-2.53	.675	8.21	2.34	.00 .00
9C	21.90	.556	18.94	-4.829	2.93	-2.21	.693	8.92	4.29	.00 .00
10C	20.30	.541	17.49	-4.867	2.85	-1.91	.682	7.92	1.56	.00 .00
11C	21.70	.569	19.83	-7.156	1.73	-.48	.752	9.82	7.15	.00 .00
12C	21.60	.558	19.91	-8.035	1.46	.30	.752	9.58	4.55	.00 .00
13C	21.80	.559	20.09	-8.078	1.46	.43	.748	9.65	7.15	.00 .00
1S	21.70	.563	19.54	-6.365	2.00	-.72	.731	9.45	5.20	.00 .00
2S	22.10	.566	20.54	-8.680	1.35	.28	.768	10.15	9.10	.00 .00
4S	21.50	.532	17.87	-4.288	3.39	-1.63	.632	7.64	1.95	.00 .00
5S	22.20	.558	19.49	-5.344	2.53	-1.34	.702	9.19	4.29	.00 .00
6S	21.70	.52	18.88	-5.021	2.75	-1.89	.697	8.83	5.20	.00 .00
1T	20.80	.550	18.14	-5.045	2.73	-2.22	.704	8.52	2.34	.00 .00
2T	20.60	.543	17.72	-4.744	2.97	-2.33	.685	8.11	1.56	.00 .00
3T.*	20.80	.546	17.16	-3.804	4.29	-5.08	.663	7.96	1.95	.00 .00
4T	20.70	.548	18.16	-5.225	2.59	-2.03	.711	8.52	2.99	.00 .00
5T	20.60	.533	17.34	-4.398	3.28	-2.24	.655	7.60	1.30	.00 .00

AVERAGES: 80405 BASELINE W079 00 000

21.53 .546 19.54 -7.054 1.73 -.03 .731 9.10 5.81 .00 .00

STD .17 .004 .35 .819 .23 .30 .018 .33 1.05 \* \*

80405 W120N/CRO02 (3E14)

21.35 .553 18.91 -5.949 2.36 -1.22 .713 8.91 4.40 .00 .00

STD .55 .010 .95 1.359 .63 .94 .035 .74 2.30 \* \*

PERCENT OF BASELINE

99.2 101.2 96.7 115.7 136 \*\*\*\*\* 97.4 98.0 75.8 \*\*\*\*\* \*\*\*\*\*

STD% 3.3 2.5 6.7 31.3 60 \*\*\*\*\* 7.4 11.9 60.5 \*\*\*\*\* \*\*\*\*\*



TABLE 16 SOLAR CELL I-V DATA (Cont.)

80403 W\*118PH003 (1.4E17) LOW RESISTIVITY W057 00 000  
 \*SOL8 1 /14/80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	R	FF	Eff	OCD	PCDa	PCDb
1R*	20.50	.550	20.06	-6.001	2.11	-.55	.712	9.32	.00	.00	.00
1B*	21.10	.559	17.97	-4.736	3.05	-1.32	.657	8.20	.65	.00	.00
2B*	21.00	.561	17.90	-4.751	3.05	-1.37	.659	8.21	1.69	.00	.00
3B	21.40	.579	18.85	-5.387	2.60	-1.72	.711	9.32	.91	.00	.00
1C	21.60	.573	18.42	-4.530	3.34	-2.60	.676	8.85	2.60	.00	.00
2C	22.00	.581	19.94	-6.621	1.96	-.80	.743	10.05	6.50	.00	.00
3C	21.50	.579	19.62	-6.975	1.82	-.76	.754	9.93	5.85	.00	.00
4C	21.70	.561	18.95	-5.215	2.64	-1.38	.694	8.93	3.90	.00	.00
5C	21.90	.570	18.94	-4.909	2.93	-1.86	.687	9.07	2.34	.00	.00
6C	21.60	.566	18.66	-4.892	2.93	-1.86	.685	8.86	2.21	.00	.00
7C	21.60	.576	19.49	-6.391	2.04	-.94	.738	9.71	5.20	.00	.00
1S	21.20	.564	18.18	-4.685	3.13	-2.33	.681	8.61	1.82	.00	.00
2S	21.60	.565	13.60	-4.841	2.97	-1.81	.680	8.77	2.34	.00	.00
3S	21.50	.558	18.40	-4.863	2.92	-1.05	.660	8.37	1.43	.00	.00
1T	22.70	.552	20.12	-5.775	2.23	-.68	.706	9.35	21.00	.00	.00
2T	22.20	.547	20.31	-7.394	1.59	.02	.744	9.55	26.00	.00	.00
3T	22.00	.554	18.23	-4.155	3.70	-2.24	.636	8.19	2.60	.00	.00
AVERAGES: 80403 BASELINE W057 00 000											
	21.40	.579	18.85	-5.387	2.60	-1.72	.711	9.32	.91	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
80403 W*118PH003 (1.4E17) LOW RESISTIVITY											
	21.78	.565	19.07	-5.480	2.63	-1.41	.699	9.10	6.45	.00	.00
STD	.37	.010	.72	.998	.62	.75	.035	.56	7.50	*	*
PERCENT OF BASELINE											
	101.8	97.6	101.1	98.3	101	118.3	98.2	97.6	708.3	*****	*****
STD%	1.7	1.8	3.8	18.5	24	43.4	4.9	6.0	823.7	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80424 W121N/TI002 (3.9E13) W079 00 000

\*SOL8 1 / 8 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.558	19.95	-6.845	1.80	-.87	.755	9.75	.00	.00	.00
1B*	19.80	.530	17.26	-5.191	2.54	-1.55	.693	7.69	1.30	.00	.00
2B	21.50	.553	19.79	-7.836	1.50	.07	.754	9.48	5.85	.00	.00
3B	21.40	.539	19.04	-6.212	1.98	.27	.694	8.46	3.90	.00	.00
4B	21.40	.541	19.03	-6.122	2.03	.03	.697	8.54	3.90	.00	.00
5B	21.20	.540	19.01	-6.535	1.86	.30	.705	8.54	4.29	.00	.00
1C	19.70	.517	16.51	-4.463	3.13	-1.61	.641	6.90	1.17	.00	.00
2C	19.50	.524	16.68	-4.673	2.95	-2.33	.676	7.31	1.17	.00	.00
3C	19.70	.524	17.09	-5.171	2.53	-1.12	.680	7.42	1.69	.00	.00
4C	19.70	.512	16.39	-4.363	3.22	-1.57	.631	6.73	.91	.00	.00
5C	19.60	.526	17.24	-5.665	2.22	-.50	.690	7.52	1.95	.00	.00
6C	19.50	.523	17.00	-5.394	2.37	-.66	.679	7.33	1.30	.00	.00
7C	20.00	.521	16.95	-4.558	3.04	-2.00	.661	7.28	1.30	.00	.00
8C	19.60	.521	17.11	-5.507	2.29	-.35	.677	7.31	1.69	.00	.00
9C	21.50	.538	18.76	-5.444	2.38	-.37	.677	8.28	3.25	.00	.00
10C	19.90	.525	17.44	-5.535	2.29	-.59	.686	7.58	1.69	.00	.00
11C	19.70	.526	17.64	-6.356	1.89	-.19	.712	7.80	2.08	.00	.00
1S	19.90	.530	17.81	-6.330	1.91	-.16	.711	7.93	2.60	.00	.00
2S	19.90	.532	17.71	-5.925	2.10	-.87	.714	7.99	2.47	.00	.00
3S	19.70	.526	17.23	-5.440	2.35	-.82	.687	7.53	1.95	.00	.00
4S	19.80	.525	17.44	-5.653	2.22	-.71	.696	7.65	1.95	.00	.00
5S	19.80	.521	16.63	-4.320	3.32	-2.72	.658	7.17	1.04	.00	.00
6S	20.00	.525	17.50	-5.406	2.37	-.94	.689	7.65	2.08	.00	.00
1T	19.80	.519	16.44	-4.260	3.39	-2.11	.636	6.91	1.04	.00	.00
2T	20.30	.536	18.46	-6.954	1.70	-.41	.742	8.54	1.30	.00	.00
3T	19.90	.526	17.41	-5.393	2.38	-1.01	.690	7.64	1.69	.00	.00
4T	19.90	.523	17.23	-5.106	2.57	-1.18	.678	7.46	1.30	.00	.00
5T	19.70	.522	17.01	-5.051	2.61	-1.22	.675	7.34	1.56	.00	.00
AVERAGES: 80424 BASELINE W079 00 000											
	21.38	.543	19.22	-6.676	1.84	.17	.713	8.76	4.49	.00	.00
STD	.11	.006	.33	.687	.21	.12	.024	.42	.80	*	*
80424 W121N/TI002 (3.9E13)											
	19.87	.525	17.26	-5.317	2.51	-1.07	.681	7.51	1.69	.00	.00
STD	.40	.006	.58	.688	.46	.70	.026	.42	.56	*	*
PERCENT OF BASELINE											
	93.0	96.6	89.8	120.4	136	*****	95.6	85.8	37.7	*****	*****
STD%	2.3	2.1	4.6	19.6	44	*****	7.0	9.1	21.6	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80425 W122TI007 (8.4E13) W097 0 000

\*SOL8 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.557	19.85	-6.482	1.93	-1.20	.752	9.70	.00	.00	.00
1B	22.20	.551	20.12	-6.638	1.85	-.67	.742	9.59	5.20	.00	.00
2B.*	22.30	.546	19.91	-5.840	2.18	-1.28	.728	9.37	4.42	.00	.00
3B	22.20	.548	19.94	-6.150	2.04	-.97	.732	9.42	4.16	.00	.00
4B*	22.30	.543	19.38	-4.995	2.71	-1.78	.695	8.90	2.99	.00	.00
5B.*	22.30	.549	19.89	-5.828	2.20	-1.25	.726	9.40	4.55	.00	.00
1C	14.10	.468	12.09	-5.214	2.32	-.55	.654	4.56	.52	.00	.00
2C	13.90	.468	12.12	-5.730	2.02	.10	.669	4.60	.52	.00	.00
3C	13.90	.469	12.23	-6.018	1.88	.31	.678	4.68	.65	.00	.00
4C	13.90	.470	12.25	-6.042	1.88	.11	.684	4.72	.78	.00	.00
5C	13.90	.467	12.26	-6.117	1.83	.36	.681	4.68	.65	.00	.00
6C	14.30	.469	12.63	-6.154	1.82	.36	.684	4.85	.91	.00	.00
7C	14.00	.462	12.07	-5.392	2.18	-.20	.657	4.49	.65	.00	.00
8C	13.80	.465	12.10	-5.934	1.91	.37	.673	4.56	.65	.00	.00
9C	14.00	.469	12.20	-5.702	2.04	.02	.669	4.65	.78	.00	.00
10C	13.70	.468	12.09	-6.112	1.84	.29	.683	4.63	.78	.00	.00
11C	13.90	.459	11.83	-5.086	2.37	-.46	.643	4.34	.39	.00	.00
1S	14.20	.472	12.55	-6.145	1.83	.24	.686	4.85	.78	.00	.00
2S	14.20	.470	12.47	-5.935	1.92	.20	.677	4.78	.78	.00	.00
3S	14.10	.469	12.43	-6.063	1.86	.20	.683	4.78	.78	.00	.00
4S	14.10	.469	12.48	-6.309	1.76	.73	.681	4.77	.91	.00	.00
5S	14.20	.467	12.36	-5.603	2.08	-.26	.671	4.70	.78	.00	.00
6S	14.20	.470	12.49	-6.020	1.88	.32	.678	4.79	.91	.00	.00
1T	13.90	.468	12.01	-5.391	2.21	-.49	.663	4.56	.91	.00	.00
2T	14.00	.464	12.00	-5.216	2.31	-.48	.652	4.48	.91	.00	.00
3T	13.80	.466	12.11	-5.892	1.93	.08	.677	4.61	.91	.00	.00
4T	13.90	.457	11.69	-4.822	2.57	-.86	.633	4.25	.65	.00	.00
AVERAGES: 80425 BASELINE W097 0 000											
	22.20	.550	20.03	-6.394	1.94	-.82	.737	9.50	4.68	.00	.00
STD	.00	.002	.09	.244	.09	.15	.005	.09	.52	*	*
80425 W122TI007 (8.4E13)											
	14.00	.467	12.21	-5.757	2.02	.02	.670	4.64	.74	.00	.00
STD	.16	.004	.24	.406	.22	.39	.014	.15	.15	*	*
PERCENT OF BASELINE											
	63.1	85.0	61.0	110.0	104	202.3	91.0	48.8	15.9	*****	*****
STD%	.7	.9	1.5	10.0	17	56.7	2.6	2.1	5.2	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80427 W123T1008 (1.05E14) W097 00 000

\*SOL8 1 / 8 / 90 AM1: P0-91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.555	19.76	-6.233	2.03	-1.39	.748	9.61	.00	.00	.00
1B.	22.20	.549	19.46	-5.191	2.59	-1.79	.707	9.11	4.16	.00	.00
2B.	22.10	.546	19.76	-5.988	2.10	-1.01	.726	9.26	3.90	.00	.00
3B*	22.20	.536	18.84	-4.466	3.18	-2.21	.667	8.40	2.86	.00	.00
4B*	22.30	.536	19.19	-5.129	2.57	-.25	.657	8.30	4.16	.00	.00
5B*	22.30	.536	18.75	-4.221	3.48	-2.87	.664	8.40	3.25	.00	.00
2C	14.80	.468	12.99	-5.930	1.91	.33	.674	4.94	.78	.00	.00
3C	14.40	.469	12.65	-5.924	1.92	.12	.679	4.85	.91	.00	.00
4C	14.40	.464	12.42	-5.437	2.16	.04	.655	4.63	.65	.00	.00
5C	14.40	.470	12.69	-6.071	1.86	.31	.681	4.87	.78	.00	.00
6C	14.30	.468	12.71	-6.478	1.69	.85	.685	4.85	.91	.00	.00
7C	14.50	.466	12.63	-5.764	1.98	.53	.661	4.72	.78	.00	.00
8C	14.60	.462	12.58	-5.454	2.13	.27	.651	4.64	.91	.00	.00
9C	14.10	.464	12.30	-5.837	1.94	.55	.664	4.59	.91	.00	.00
10C	14.30	.464	12.33	-5.505	2.12	.39	.651	4.56	.65	.00	.00
11C	14.40	.466	12.55	-5.722	2.01	.18	.667	4.73	.91	.00	.00
12C	14.50	.468	12.72	-6.035	1.86	.78	.668	4.80	.39	.00	.00
1S	14.70	.479	13.07	-6.425	1.74	.63	.689	5.13	.39	.00	.00
2S	14.10	.474	12.67	-7.013	1.53	1.19	.697	4.93	.65	.00	.00
3S	14.30	.475	12.77	-6.716	1.63	1.03	.690	4.96	.78	.00	.00
4S	14.40	.474	12.79	-6.450	1.72	.83	.685	4.94	.65	.00	.00
5S	14.40	.470	12.57	-5.780	1.99	.32	.667	4.77	.78	.00	.00
6S	14.40	.473	12.64	-6.348	1.75	1.97	.654	4.71	.78	.00	.00
1T	14.20	.473	12.34	-5.699	2.05	.40	.661	4.69	.91	.00	.00
2T	14.20	.470	12.29	-5.473	2.17	-.26	.663	4.68	.91	.00	.00
3T	14.20	.468	12.29	-5.421	2.19	-.53	.667	4.68	.78	.00	.00
4T	14.30	.466	12.52	-5.937	1.90	.62	.667	4.70	.65	.00	.00
5T	14.30	.467	12.40	-5.548	2.11	.01	.662	4.67	.65	.00	.00

AVERAGES: 80427 BASELINE W097 00 000

	22.15	.548	19.61	-5.590	2.55	-1.40	.715	9.19	4.63	.00	.00
STD	.05	.002	.15	.396	.24	.39	.009	.07	.13	*	*
	80427 W123T1008 (1.05E14)										
	14.37	.469	12.59	-5.953	1.93	.48	.676	4.78	.75	.00	.00
STD	.17	.003	.21	.436	.15	.51	.013	.14	.15	*	*
PERCENT OF BASELINE											
	64.9	65.7	64.2	93.5	82	234.3	93.5	52.0	13.6	*****	*****
STD	.9	1.0	1.6	16.0	17	56.3	3.1	1.9	4.5	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80531 W124M0003 (1.8E10) W097 00 000

\*SOL9 1/14/80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.556	19.84	-6.498	1.92	-1.11	.750	9.65	.00	.00	.00
1B	22.00	.549	19.67	-6.016	2.10	-.91	.723	9.24	3.77	.00	.00
2B	21.70	.546	19.67	-6.743	1.80	-.39	.736	9.22	3.64	.00	.00
3B*	22.10	.540	18.88	-4.699	2.96	-1.57	.666	8.41	2.21	.00	.00
4B*	20.40	.544	18.05	-5.612	2.32	-1.34	.712	8.36	3.25	.00	.00
5B	22.10	.546	19.52	-5.483	2.38	-1.42	.713	9.10	3.51	.00	.00
1C	21.60	.546	19.77	-7.303	1.62	-.32	.752	9.38	3.25	.00	.00
2C	21.50	.538	18.46	-4.756	2.91	-1.87	.678	8.29	1.95	.00	.00
3C	21.70	.542	19.29	-5.774	2.20	-1.09	.717	8.92	2.21	.00	.00
4C	21.90	.546	19.72	-6.340	1.95	-.74	.732	9.25	2.86	.00	.00
5C	21.90	.540	19.44	-5.752	2.20	-.95	.712	8.91	2.86	.00	.00
7C	21.50	.543	19.64	-7.157	1.65	-.42	.750	9.27	3.38	.00	.00
8C	21.80	.542	19.30	-5.588	2.31	-1.33	.715	8.94	2.99	.00	.00
9C	21.80	.538	18.99	-5.100	2.61	-1.57	.694	8.61	2.86	.00	.00
10C	21.80	.538	18.56	-4.591	3.07	-1.89	.666	8.27	1.95	.00	.00
11C	21.50	.540	18.98	-5.502	2.35	-1.39	.712	8.74	2.99	.00	.00
12C	21.60	.541	19.54	-6.546	1.85	-.72	.739	9.13	3.25	.00	.00
1S	21.40	.544	18.87	-5.415	2.43	-1.65	.714	8.79	3.25	.00	.00
2S	21.30	.543	19.72	-5.930	2.13	-1.09	.724	8.85	3.12	.00	.00
3S	21.50	.545	19.50	-6.701	1.81	-.66	.743	9.20	3.64	.00	.00
4S	21.70	.539	18.88	-5.011	2.69	-1.90	.698	8.63	2.60	.00	.00
5S	21.60	.542	19.08	-5.498	2.36	-1.44	.713	8.83	3.25	.00	.00
1T	21.60	.547	19.59	-6.776	1.79	-.45	.739	9.23	4.16	.00	.00
2T	21.60	.544	19.49	-6.427	1.91	-.76	.735	9.14	3.64	.00	.00
3T	21.70	.546	19.90	-7.511	1.56	-.11	.751	9.41	3.90	.00	.00
4T	21.40	.540	19.03	-5.797	2.19	-1.16	.718	8.77	2.86	.00	.00
5T	21.70	.533	18.39	-4.559	3.07	-1.68	.656	8.04	1.69	.00	.00

AVERAGES: 80531 BASELINE W097 00 000

	21.93	.547	19.62	-6.081	2.09	-.91	.724	9.18	3.64	.00	.00
STD	.17	.001	.07	.517	.24	.42	.009	.06	.11	*	*
	80531 W124M0003 (1.8E10)										
	21.62	.542	19.21	-5.906	2.22	-1.10	.717	8.89	2.98	.00	.00
STD	.16	.003	.43	.856	.45	.54	.026	.36	.62	*	*
	PERCENT OF BASELINE										
	98.6	99.0	97.9	102.9	106	78.8	99.1	96.7	82.0	*****	*****
STDZ	1.5	.9	2.5	23.5	36	142.4	4.9	4.6	20.0	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80601 W125M0004 (3E11) W097 00 000

\*SOL9 1 /5 /80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	CCB	PCDa	PCDb
2R*	21.90	.558	20.18	-7.719	1.54	-.34	.765	9.88	.00	.00	.00
1B	22.00	.549	20.00	-6.925	1.74	-.28	.739	9.43	3.25	.00	.00
2B	22.10	.549	20.11	-7.045	1.70	-.11	.737	9.46	3.90	.00	.00
3B	21.90	.548	19.73	-6.501	1.89	-.31	.724	9.19	3.90	.00	.00
4B	22.10	.548	20.09	-6.875	1.75	-.42	.742	9.50	3.77	.00	.00
5B	22.00	.549	19.72	-6.199	2.02	-.59	.721	9.21	3.64	.00	.00
1C	21.20	.535	18.49	-5.128	2.59	-1.66	.697	8.36	1.56	.00	.00
2C	20.80	.536	18.59	-5.965	2.09	-1.15	.726	8.56	1.95	.00	.00
3C	21.30	.535	19.02	-6.016	2.06	-.83	.720	8.67	1.82	.00	.00
4C	21.20	.538	19.23	-6.742	1.77	-.57	.741	8.94	2.08	.00	.00
5C	21.20	.538	18.82	-5.693	2.24	-1.30	.718	8.66	2.08	.00	.00
6C	21.00	.534	17.97	-4.626	3.02	-2.37	.680	8.06	1.30	.00	.00
7C	21.00	.536	18.48	-5.420	2.39	-1.42	.707	8.41	1.82	.00	.00
8C	21.10	.535	18.85	-6.043	2.05	-.81	.720	8.59	1.56	.00	.00
9C	21.00	.535	18.75	-5.972	2.08	-.99	.722	8.58	2.08	.00	.00
10C	21.10	.534	18.87	-6.071	2.03	-.84	.722	8.61	1.95	.00	.00
11C	20.90	.533	18.40	-5.400	2.39	-1.53	.709	8.35	1.69	.00	.00
12C	21.00	.522	17.64	-4.611	2.97	-.71	.632	7.33	.91	.00	.00
1S	21.10	.536	18.97	-6.344	1.92	-.62	.727	8.69	2.21	.00	.00
2S	21.20	.535	18.80	-5.736	2.20	-1.01	.712	8.54	1.95	.00	.00
3S	21.10	.535	18.95	-6.241	1.96	-.77	.727	8.68	1.95	.00	.00
4S	21.20	.529	18.40	-5.660	2.61	-1.49	.688	8.16	1.30	.00	.00
5S	21.10	.538	18.98	-6.306	1.94	-.80	.731	8.78	2.47	.00	.00
6S	21.00	.536	18.73	-5.948	2.10	-.95	.720	8.57	1.95	.00	.00
1T	20.80	.536	18.39	-5.554	2.31	-1.39	.713	8.40	1.95	.00	.00
2T	20.70	.535	18.18	-5.302	2.47	-1.78	.709	8.31	1.69	.00	.00
3T	20.80	.524	17.66	-4.612	2.99	-1.70	.660	7.61	.91	.00	.00
4T	20.90	.523	18.26	-5.013	2.62	-2.42	.712	8.23	1.56	.00	.00
5T	20.80	.535	18.57	-5.928	2.10	-1.16	.725	8.53	2.34	.00	.00
AVERAGES: 80601 BASELINE W097 00 000											
	22.02	.549	19.93	-6.709	1.82	-.34	.732	9.36	3.69	.00	.00
STD	.07	.000	.17	.313	.12	.16	.008	.13	.24	*	*
80601 W125M0004 (3E11)											
	21.02	.534	18.57	-5.640	2.30	-1.23	.709	8.42	1.79	.00	.00
STD	.16	.004	.41	.581	.35	.50	.024	.36	.39	*	*
PERCENT OF BASELINE											
	95.5	97.3	93.2	115.9	126	*****	96.9	90.0	48.4	*****	*****
STDZ	1.1	.9	2.9	13.0	29	387.9	4.4	5.1	14.5	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80602 W126MULTI001 W097 00 000

\*SOL9 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.558	20.06	-7.244	1.67	-.55	.758	9.79	.00	.00	.00
1B*	21.60	.545	19.29	-6.001	2.10	-.86	.720	8.96	3.64	.00	.00
2B	21.90	.548	19.90	-6.893	1.75	-.36	.740	9.39	4.68	.00	.00
3B*	21.70	.550	19.65	-7.019	1.72	.42	.719	9.07	4.55	.00	.00
4B	21.60	.550	19.85	-7.604	1.55	-.18	.756	9.50	4.94	.00	.00
1C	19.30	.532	17.37	-6.566	1.83	-.14	.719	7.80	1.30	.00	.00
2C	19.90	.530	17.78	-6.217	1.96	-.34	.711	7.93	1.30	.00	.00
3C	19.70	.528	17.43	-5.870	2.12	-.38	.697	7.66	1.04	.00	.00
4C	19.50	.530	17.63	-6.783	1.75	-.10	.726	7.93	1.30	.00	.00
5C	19.90	.525	17.29	-5.220	2.49	-1.02	.680	7.52	.91	.00	.00
6C	19.90	.529	17.72	-6.028	2.04	-.59	.710	7.91	1.30	.00	.00
7C	19.70	.529	17.63	-6.135	1.99	-.87	.723	7.97	1.30	.00	.00
8C	19.70	.532	17.65	-6.217	1.97	-.67	.721	7.99	1.30	.00	.00
9C	19.60	.529	17.47	-5.968	2.07	-.94	.717	7.86	1.30	.00	.00
10C	19.90	.529	17.75	-6.013	2.05	-.83	.717	7.98	1.17	.00	.00
11C	19.90	.529	17.86	-6.387	1.89	-.33	.718	7.99	1.30	.00	.00
12C	19.60	.523	16.98	-5.089	2.58	-1.38	.681	7.38	.91	.00	.00
13C	19.50	.525	17.02	-5.340	2.42	-1.06	.687	7.44	.91	.00	.00
1S	20.00	.533	17.59	-5.485	2.35	-1.21	.701	7.90	1.30	.00	.00
2S	20.00	.532	17.91	-6.218	1.97	-.62	.720	8.10	1.56	.00	.00
3S	19.90	.532	17.76	-6.038	2.05	-.83	.718	8.04	1.56	.00	.00
4S	20.00	.530	17.63	-5.582	2.28	-1.06	.702	7.87	1.30	.00	.00
5S	20.20	.530	17.93	-5.857	2.13	-.80	.709	8.03	1.30	.00	.00
1T	19.40	.532	17.53	-6.689	1.79	-.30	.728	7.95	1.43	.00	.00
2T	19.50	.528	17.23	-5.679	2.22	-1.01	.705	7.67	1.04	.00	.00
3T	19.20	.530	16.95	-5.873	2.13	-.18	.690	7.43	1.17	.00	.00
4T	19.50	.526	17.10	-5.389	2.39	-1.38	.699	7.59	1.04	.00	.00
5T	19.30	.525	16.89	-5.383	2.39	-1.18	.693	7.42	.91	.00	.00
AVERAGES: 80602 BASELINE W097 00 000											
	21.75	.549	19.88	-7.249	1.65	-.27	.748	9.45	4.81	.00	.00
STD	.15	.001	.02	.356	.10	.09	.008	.05	.13	*	*
80602 W126MULTI001											
	19.70	.529	17.48	-5.914	2.12	-.75	.708	7.80	1.22	.00	.00
STD	.26	.003	.32	.456	.23	.39	.014	.23	.19	*	*
PERCENT OF BASELINE											
	90.6	96.4	88.0	118.4	129	-75.8	94.6	82.6	25.3	*****	*****
STD%	1.8	.7	1.7	10.6	22	276.9	2.9	2.9	4.7	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80530 W127FZ/TI001 (3.9E13) WITH CZ BASES ADDED CB W101 00 000  
 \*SOL9 1 / 8 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.556	19.95	-6.826	1.80	-.87	.754	9.71	.00	.00	.00
1B.*	22.30	.545	19.87	-5.844	2.17	-1.07	.721	9.27	3.64	.00	.00
2B*	22.30	.539	19.00	-4.465	3.20	-2.59	.679	8.63	2.47	.00	.00
3B.*	22.30	.546	19.76	-5.580	2.32	-1.36	.717	9.23	3.64	.00	.00
4B*	21.70	.535	18.34	-4.358	3.32	-2.62	.667	8.19	2.08	.00	.00
5B*	22.30	.541	19.40	-4.990	2.71	-1.91	.699	8.91	3.25	.00	.00
1CB.*	22.60	.547	20.05	-5.722	2.24	-.97	.712	9.31	3.51	.00	.00
2CB	22.60	.547	20.53	-6.833	1.76	-.39	.740	9.67	4.42	.00	.00
3CB	22.80	.548	20.51	-6.300	1.97	-.65	.729	9.63	3.77	.00	.00
4CB.*	22.60	.546	20.11	-5.765	2.21	-1.12	.719	9.39	4.42	.00	.00
5CB*	22.90	.543	19.67	-4.692	2.97	-2.01	.682	8.97	2.99	.00	.00
1C	14.20	.466	12.40	-5.835	1.95	.43	.667	4.67	.65	.00	.00
2C	14.10	.463	12.29	-5.746	1.99	.26	.666	4.60	.39	.00	.00
3C	14.40	.464	12.57	-5.703	2.01	-.13	.673	4.76	.65	.00	.00
4C	14.30	.463	12.56	-5.949	1.88	.27	.676	4.73	.52	.00	.00
5C	14.20	.462	12.46	-5.949	1.88	.32	.675	4.68	.91	.00	.00
6C	14.30	.462	12.58	-6.032	1.84	.39	.677	4.73	.78	.00	.00
7C	14.20	.459	12.38	-5.713	1.98	.12	.668	4.60	.78	.00	.00
8C	14.20	.460	12.46	-5.931	1.88	.32	.674	4.66	.78	.00	.00
1S	14.30	.462	12.45	-5.702	2.00	.25	.664	4.64	.52	.00	.00
2S	14.30	.463	12.48	-5.759	1.98	.22	.668	4.68	.65	.00	.00
3S	14.20	.463	12.44	-5.941	1.89	.51	.670	4.66	.78	.00	.00
4S	14.20	.460	12.41	-5.800	1.94	.24	.669	4.62	.78	.00	.00
5S	14.50	.460	12.54	-5.520	2.09	.15	.657	4.64	.65	.00	.00
1T	14.00	.460	12.23	-5.831	1.93	.34	.668	4.55	2.21	.00	.00
2T	14.30	.462	12.45	-5.702	2.00	.25	.664	4.64	.78	.00	.00
3T	14.40	.462	12.57	-5.789	1.95	.35	.667	4.69	.65	.00	.00
4T	14.30	.459	12.41	-5.569	2.06	-.03	.664	4.61	.78	.00	.00

AVERAGES: 80530 BASELINE W101 00 000

	22.30	.546	19.81	-5.712	2.25	-1.22	.719	9.25	3.64	.00	.00
STD	.00	.000	.06	.132	.08	.15	.002	.02	.00	*	*

80530 W127FZ/TI001 WITH CZ BASES ADDED PC

	15.86	.478	13.95	-5.861	1.97	.05	.679	5.58	1.40	.00	.00
STD	3.30	.034	3.08	.272	.11	.45	.023	1.90	1.33	*	*

PERCENT OF BASELINE

	71.1	87.6	70.4	97.4	88	204.4	94.5	60.3	38.4	*****	*****
STDZ	14.8	6.2	15.8	7.2	8	41.5	3.5	20.8	36.6	*****	*****



TABLE 16 SOLAR CELL I-V DATA (Cont.)

80603 W128TA002 (1.7E11) W097 00 000

\*SOL9 1 / 8 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.556	19.87	-6.535	1.90	-1.15	.752	9.69	.00	.00	.00
1B	21.80	.550	19.93	-7.124	1.68	-.60	.755	9.58	4.16	.00	.00
2B.*	21.90	.547	19.37	-5.513	2.37	-1.49	.716	9.07	3.38	.00	.00
3B*	16.10	.185	11.02	-12.761	.28	7.29	.356	1.12	.00	.00	.00
4B.*	21.90	.543	19.02	-4.924	2.78	-2.13	.699	8.79	2.86	.00	.00
5B	22.10	.549	20.18	-6.960	1.73	-.80	.757	9.72	4.42	.00	.00
1C	21.60	.547	19.71	-7.122	1.67	-.37	.748	9.34	2.99	.00	.00
2C	21.10	.546	18.76	-5.704	2.26	-1.44	.722	8.80	3.12	.00	.00
3C	21.30	.546	19.15	-6.292	1.97	-.78	.730	8.98	2.99	.00	.00
4C	21.50	.547	19.66	-7.277	1.63	-.23	.748	9.30	3.51	.00	.00
5C	21.40	.546	19.55	-7.163	1.66	-.39	.750	9.26	3.51	.00	.00
6C	21.30	.546	19.30	-6.711	1.81	-.51	.738	9.08	3.51	.00	.00
7C	21.30	.546	19.33	-6.794	1.78	-.46	.739	9.09	3.51	.00	.00
8C	21.50	.544	19.39	-6.371	1.93	-.91	.738	9.12	3.25	.00	.00
9C	21.40	.546	19.44	-6.894	1.75	-.36	.739	9.14	2.60	.00	.00
10C	21.40	.537	18.21	-4.542	3.12	-2.21	.670	8.14	3.38	.00	.00
11C	21.40	.540	19.18	-6.185	2.00	-.72	.724	8.85	1.82	.00	.00
12C	21.50	.545	19.13	-5.802	2.20	-1.16	.720	8.92	2.60	.00	.00
1S	21.30	.550	19.38	-6.917	1.75	-.47	.744	9.21	3.51	.00	.00
2S	21.30	.544	18.42	-4.833	2.87	-2.25	.693	8.49	2.86	.00	.00
3S	21.40	.546	18.93	-5.554	2.35	-1.42	.715	8.83	2.99	.00	.00
4S	21.40	.548	19.36	-6.573	1.87	-.67	.738	9.15	3.12	.00	.00
5S	21.50	.546	19.42	-6.510	1.88	-.67	.736	9.13	3.12	.00	.00
1T	21.30	.547	18.40	-5.093	2.67	-.86	.670	8.26	2.60	.00	.00
2T	21.20	.549	19.43	-7.394	1.60	-.33	.755	9.29	3.25	.00	.00
3T	21.30	.546	18.88	-5.652	2.29	-1.28	.715	8.80	1.56	.00	.00
4T	21.60	.537	18.56	-4.834	2.83	-1.53	.674	8.26	3.25	.00	.00
5T	21.40	.547	19.43	-6.781	1.79	-.54	.741	9.18	2.99	.00	.00
AVERAGES: 80603 BASELINE W097 00 000											
	21.95	.550	20.05	-7.042	1.71	-.70	.756	9.65	4.29	.00	.00
STD	.15	.001	.12	.082	.02	.10	.001	.07	.13	*	*
80603 W128TA002 (1.7E11)											
	21.38	.545	19.14	-6.227	2.08	-.89	.725	8.94	3.00	.00	.00
STD	.12	.003	.42	.837	.43	.57	.025	.35	.51	*	*
PERCENT OF BASELINE											
	97.4	99.2	95.4	111.6	122	72.9	95.8	92.6	70.0	*****	*****
STDZ	1.2	.7	2.7	13.0	28	112.2	3.5	4.3	14.3	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

81026 W131MN008 (5.5E14) THREE INCH MATERIAL W117 00 000

\*SOL10 1 / 8 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.560	19.74	-6.290	2.02	-1.02	.738	9.57	.00	.00	.00
11B	21.90	.555	20.12	-7.704	1.53	.13	.749	9.63	4.29	.00	.00
12B	22.20	.555	20.53	-8.169	1.42	.12	.761	9.92	3.90	.00	.00
13B.*	22.20	.552	19.82	-5.940	2.15	-.96	.722	9.35	3.64	.00	.00
14B	22.30	.556	20.70	-8.521	1.35	.21	.766	10.05	4.55	.00	.00
21B	22.30	.556	20.74	-8.664	1.32	.19	.770	10.10	4.03	.00	.00
22B	22.30	.556	20.74	-8.664	1.32	.19	.770	10.10	4.55	.00	.00
23B	22.30	.556	20.61	-8.084	1.44	.04	.762	9.99	4.94	.00	.00
24B	22.30	.556	20.65	-8.209	1.42	.02	.766	10.04	5.20	.00	.00
31B.*	22.10	.560	20.05	-6.313	2.01	-1.84	.766	10.03	3.00	.00	.00
32B	22.30	.560	20.39	-7.334	1.65	-.06	.745	9.83	4.94	.00	.00
33B	22.30	.560	20.61	-8.049	1.46	-.07	.765	10.10	5.20	.00	.00
34B	22.30	.558	20.18	-6.670	1.86	-.38	.733	9.65	4.68	.00	.00
41B	22.30	.558	20.65	-8.233	1.42	.02	.766	10.08	4.68	.00	.00
42B	22.60	.555	20.78	-7.673	1.54	-.07	.755	10.02	4.29	.00	.00
11	20.60	.527	17.65	-4.800	2.83	-1.57	.670	7.69	1.56	.00	.00
12	20.70	.534	18.45	-5.910	2.11	-1.01	.719	8.41	1.56	.00	.00
13	20.40	.536	18.32	-6.331	1.93	-.55	.723	8.36	.78	.00	.00
14	20.40	.525	17.30	-4.551	3.06	-2.03	.662	7.50	.46	.00	.00
15	20.30	.539	18.53	-7.122	1.66	-.50	.750	8.68	1.30	.00	.00
16	20.30	.534	17.84	-5.512	2.34	-.99	.697	7.99	.78	.00	.00
17	20.40	.537	18.28	-6.099	2.03	-1.04	.728	8.43	.91	.00	.00
18	20.30	.539	18.48	-6.920	1.72	-.64	.748	8.65	1.30	.00	.00
19	20.30	.538	18.40	-6.704	1.79	-.64	.740	8.55	1.30	.00	.00
110	19.80	.536	17.77	-6.146	2.02	-1.16	.732	8.22	1.04	.00	.00
111.*	19.40	.536	16.10	-3.767	4.35	-6.73	.688	7.56	1.30	.00	.00
21	20.60	.535	18.13	-5.433	2.38	-1.39	.705	8.22	1.04	.00	.00
22	20.60	.531	17.93	-5.271	2.47	-.91	.682	7.89	.91	.00	.00
23	21.10	.532	18.34	-5.078	2.61	-1.56	.690	8.20	.91	.00	.00
24	20.80	.536	18.44	-5.741	2.21	-1.02	.711	8.38	1.04	.00	.00
25	20.50	.533	17.81	-5.148	2.57	-1.31	.685	7.92	.91	.00	.00
26	20.50	.538	18.40	-6.273	1.96	-.70	.725	8.46	1.56	.00	.00
27	20.50	.537	18.31	-6.002	2.08	-1.02	.723	8.42	1.30	.00	.00
28	20.50	.539	18.55	-6.619	1.83	-.64	.737	8.62	1.56	.00	.00
29	20.50	.536	18.12	-5.585	2.30	-1.33	.711	8.27	1.30	.00	.00
210	20.40	.537	18.25	-6.056	2.05	-1.01	.725	8.40	1.30	.00	.00
211	19.90	.536	17.79	-6.038	2.06	-1.01	.723	8.16	1.17	.00	.00
212	19.80	.535	17.63	-5.830	2.17	-1.35	.723	8.10	1.56	.00	.00
31	20.50	.534	17.82	-5.155	2.57	-1.31	.686	7.94	.65	.00	.00
32	20.30	.537	18.09	-5.935	2.11	-.95	.717	8.27	.78	.00	.00
33	20.70	.531	17.63	-4.701	2.94	-1.53	.661	7.68	.65	.00	.00
34	20.60	.535	18.18	-5.602	2.28	-1.03	.704	8.20	1.04	.00	.00
35	20.40	.537	18.09	-5.762	2.20	-1.02	.711	8.24	1.04	.00	.00
36	20.70	.539	18.50	-6.060	2.06	-.83	.720	8.50	1.43	.00	.00
37	20.50	.535	17.93	-5.260	2.50	-1.53	.699	8.10	.91	.00	.00

TABLE 16 SOLAR CELL I-V DATA (Cont.)

38	20.70	.536	18.11	-5.318	2.46	-1.22	.694	8.14	1.04	.00	.00
39	20.50	.535	18.17	-5.700	2.23	-1.18	.713	8.27	1.04	.00	.00
310	20.80	.538	18.70	-6.291	1.95	-.79	.730	8.63	1.56	.00	.00
311	20.10	.534	17.75	-5.608	2.28	-1.17	.707	8.03	1.17	.00	.00
312	19.70	.527	17.01	-4.910	2.75	-1.96	.685	7.52	.91	.00	.00
41	20.40	.540	18.48	-6.703	1.80	-.54	.737	8.59	1.43	.00	.00
42	20.70	.540	18.75	-6.747	1.78	-.41	.735	8.69	1.69	.00	.00
43	20.80	.541	18.74	-6.413	1.91	-.71	.732	8.71	1.69	.00	.00
44	20.80	.540	18.88	-6.834	1.75	-.39	.738	8.76	1.69	.00	.00
45.*	20.90	.540	17.07	-2.854	7.50	*****	.816	9.74	1.95	.00	.00
46.*	21.00	.540	17.06	-2.805	7.79	*****	.811	9.72	1.95	.00	.00
47	20.70	.538	18.61	-6.293	1.95	-.83	.731	8.60	1.56	.00	.00
48	20.80	.534	18.31	-5.531	2.32	-1.02	.700	8.23	1.04	.00	.00
49	20.50	.535	18.36	-6.199	1.98	-.67	.721	8.37	1.30	.00	.00
410	20.60	.532	18.25	-5.670	2.23	-1.22	.713	8.27	1.04	.00	.00
411	20.20	.534	18.17	-6.325	1.93	-.81	.730	8.33	1.56	.00	.00
412	20.00	.535	17.85	-5.994	2.08	-1.00	.721	8.16	1.56	.00	.00
51	20.60	.536	18.04	-5.321	2.46	-1.35	.697	8.14	1.04	.00	.00
52	20.50	.536	18.30	-6.020	2.07	-.87	.719	8.36	1.04	.00	.00
53	20.50	.538	18.15	-5.686	2.25	-1.10	.710	8.28	1.04	.00	.00
54	20.50	.538	18.41	-6.306	1.95	-.60	.724	8.44	1.04	.00	.00
55	20.40	.537	18.39	-6.478	1.87	-.55	.729	8.45	1.30	.00	.00
56	20.50	.534	18.14	-5.705	2.22	-.95	.706	8.18	.91	.00	.00
57	20.60	.537	18.57	-6.538	1.85	-.36	.726	8.49	1.43	.00	.00
58	20.50	.537	18.57	-6.776	1.76	-.36	.734	8.55	1.17	.00	.00
59	20.30	.535	18.26	-6.552	1.84	-.07	.717	8.24	1.30	.00	.00
510	20.20	.535	18.13	-6.247	1.96	-.74	.725	8.29	1.17	.00	.00
511	19.80	.534	17.87	-6.599	1.82	-.39	.728	8.14	.91	.00	.00
512	19.70	.533	17.79	-6.716	1.78	-.17	.725	8.05	1.17	.00	.00
AVERAGES: 81026 BASELINE W117 00 000											
	22.28	.557	20.56	-7.998	1.48	.03	.759	9.96	4.60	.00	.00
STD	.15	.002	.21	.555	.15	.16	.011	.16	.41	*	*
81026 W131MN008 (5.5E14) THREE INCH MATERIAL											
	20.43	.535	18.17	-5.949	2.14	-.95	.715	8.27	1.18	.00	.00
STD	.30	.003	.36	.602	.32	.41	.020	.28	.29	*	*
PERCENT OF BASELINE											
	91.7	96.2	88.4	125.6	145	*****	94.2	83.1	25.5	*****	*****
STDZ	1.9	.9	2.7	13.2	38	*****	4.0	4.2	9.2	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80822 W132TA003 (4.2E10) W097 00 000

\*SOL9 1 / 8 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.557	19.23	-5.110	2.70	-2.46	.720	9.29	.00	.00	.00
1B	22.30	.549	20.22	-6.634	1.84	-.76	.745	9.64	3.90	.00	.00
2B	22.00	.548	19.94	-6.617	1.85	-.73	.742	9.47	3.90	.00	.00
3B	22.10	.548	19.82	-6.050	2.08	-1.17	.733	9.39	3.90	.00	.00
4B	22.60	.549	20.38	-6.324	1.96	-.90	.738	9.68	4.16	.00	.00
1C*	22.00	.552	19.02	-4.731	3.00	-2.65	.699	8.98	3.51	.00	.00
2C	21.90	.552	19.90	-6.717	1.82	-.80	.748	9.56	3.77	.00	.00
3C	22.00	.550	19.42	-5.398	2.46	-1.73	.717	9.18	3.38	.00	.00
4C	21.80	.549	19.24	-5.428	2.43	-1.63	.715	9.05	3.51	.00	.00
5C	22.10	.552	19.84	-6.122	2.06	-1.07	.733	9.46	3.90	.00	.00
6C*	22.20	.551	19.17	-5.136	2.64	-.51	.665	8.60	3.25	.00	.00
7C	21.90	.548	19.28	-5.324	2.50	-1.79	.714	9.06	3.25	.00	.00
8C	22.20	.551	20.07	-6.474	1.91	-.81	.740	9.57	3.90	.00	.00
9C	21.90	.548	19.28	-5.324	2.50	-1.79	.714	9.06	3.25	.00	.00
10C	21.90	.549	19.31	-5.378	2.47	-1.72	.715	9.10	3.51	.00	.00
11C	21.90	.550	19.67	-6.104	2.07	-1.21	.737	9.38	4.03	.00	.00
12C	22.20	.547	19.58	-5.363	2.46	-1.73	.716	9.20	3.25	.00	.00
1S	22.00	.555	19.37	-5.284	2.56	-1.93	.716	9.24	3.90	.00	.00
2S*	21.90	.546	18.60	-4.410	3.31	-2.78	.676	8.55	2.60	.00	.00
3S	22.00	.551	19.43	-5.385	2.47	-1.82	.719	9.22	3.38	.00	.00
4S	22.10	.553	20.02	-6.569	1.88	-.85	.745	9.62	3.90	.00	.00
5S	22.10	.550	19.75	-5.917	2.16	-1.18	.727	9.35	3.51	.00	.00
6S	22.20	.551	20.07	-6.438	1.92	-.90	.741	9.59	4.42	.00	.00
1T	22.00	.552	19.29	-5.209	2.60	-1.82	.708	9.09	3.25	.00	.00
2T*	22.00	.548	18.26	-3.975	3.95	-3.68	.657	8.37	2.99	.00	.00
3T	22.20	.553	19.79	-5.775	2.24	-1.40	.728	9.45	3.64	.00	.00
4T	22.10	.553	19.81	-6.075	2.09	-1.01	.729	9.42	4.29	.00	.00
5T	21.90	.553	19.95	-6.911	1.76	-.67	.751	9.62	3.90	.00	.00

AVERAGES: 80822 BASELINE W097 00 000

	22.25	.549	20.09	-6.406	1.93	-.89	.740	9.55	3.97	.00	.00
STD	.23	.000	.22	.240	.10	.17	.004	.12	.11	*	*

80822 W132TA003 (4.2E10)

	22.02	.551	19.64	-5.852	2.23	-1.36	.727	9.33	3.68	.00	.00
STD	.12	.002	.29	.546	.27	.42	.013	.20	.35	*	*

PERCENT OF BASELINE

	99.0	100.4	97.7	108.6	115	47.2	98.3	97.7	92.8	*****	*****
STD%	1.6	.5	2.5	12.3	21	86.4	2.4	3.4	11.7	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80926 W134TI009 (3E13) W117 00 000

\*SOL10 1 / 8 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.560	19.77	-6.383	1.98	-.94	.739	9.59	.00	.00	.00
1B.*	22.20	.557	19.72	-5.611	2.35	-1.59	.725	9.48	3.90	.00	.00
2B.*	22.60	.554	19.81	-5.208	2.60	-1.71	.707	9.35	3.64	.00	.00
3B	22.60	.558	20.69	-7.288	1.65	-.32	.752	10.03	3.90	.00	.00
4B.*	22.20	.555	19.87	-5.942	2.16	-1.29	.732	9.54	3.90	.00	.00
5B*	22.30	.549	19.58	-5.333	2.49	-1.36	.703	9.10	2.60	.00	.00
1C	15.30	.492	13.60	-6.295	1.83	.24	.694	5.52	.52	.00	.00
2C*	15.40	.496	13.29	-6.901	1.63	5.46	.590	4.77	.65	.00	.00
3C	16.00	.495	14.28	-6.425	1.79	.24	.699	5.86	.78	.00	.00
4C	15.50	.491	13.60	-5.757	2.08	-.30	.682	5.49	.65	.00	.00
5C	15.80	.495	14.14	-6.553	1.74	.27	.704	5.82	.65	.00	.00
6C	15.00	.490	13.43	-6.557	1.73	.16	.706	5.49	.65	.00	.00
7C	15.40	.489	13.55	-5.830	2.03	-.34	.687	5.47	.65	.00	.00
8C	15.50	.488	13.67	-6.033	1.93	.20	.683	5.47	.65	.00	.00
9C	15.70	.492	13.94	-6.167	1.88	-.06	.696	5.69	.65	.00	.00
10C	15.40	.490	13.60	-6.045	1.93	.03	.688	5.49	.78	.00	.00
11C	15.40	.490	13.74	-6.335	1.81	-.13	.705	5.62	.65	.00	.00
12C	15.40	.489	13.60	-6.000	1.95	-.11	.689	5.49	.65	.00	.00
13C	15.60	.490	13.87	-6.247	1.84	-.01	.698	5.64	.65	.00	.00
14C	15.30	.490	13.56	-6.112	1.90	-.15	.695	5.51	.65	.00	.00
15C	15.80	.492	14.06	-6.317	1.82	.16	.697	5.73	.78	.00	.00
1S	15.30	.492	13.57	-6.165	1.89	-.01	.694	5.53	.65	.00	.00
2S	15.40	.492	13.62	-6.174	1.88	.47	.683	5.47	.65	.00	.00
4S	15.40	.491	13.63	-6.071	1.93	-.15	.693	5.55	.65	.00	.00
5S	15.10	.491	13.49	-6.419	1.78	-.03	.705	5.53	.65	.00	.00
1T	15.30	.488	13.38	-5.667	2.12	-.33	.678	5.35	.65	.00	.00
2T	15.30	.488	13.50	-5.991	1.95	-.08	.688	5.43	.65	.00	.00
3T	15.10	.488	13.45	-6.338	1.80	.01	.701	5.46	.65	.00	.00
4T	15.30	.490	13.69	-.476	1.76	-.04	.708	5.61	.65	.00	.00
AVERAGES: 80926 BASELINE W117 00 000											
	22.60	.558	20.69	-7.288	1.65	-.32	.752	10.03	3.90	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
80926 W134TI009 (3E13)											
	15.42	.491	13.68	-6.181	1.88	.00	.694	5.56	.66	.00	.00
STD	.24	.002	.23	.240	.10	.20	.008	.12	.05	*	*
PERCENT OF BASELINE											
	68.2	87.9	66.1	115.2	114	200.4	92.3	55.4	17.0	*****	*****
STD%	1.0	.3	1.1	3.3	6	63.2	1.1	1.2	1.4	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80927 W135FE005 (7.8E7.8) W117 0.000

\*SOL10 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.562	19.56	-5.793	2.27	-1.59	.733	9.54	.00	.00	.00
1B	22.40	.558	20.44	-7.216	1.67	-.08	.742	9.81	4.81	.00	.00
2B	22.60	.557	20.57	-6.969	1.75	-.30	.741	9.87	5.60	.00	.00
3B	22.60	.558	20.60	-7.085	1.71	-.24	.743	9.91	4.03	.00	.00
2C.*	20.00	.528	16.74	-4.225	3.9	-3.04	.657	7.34	.91	.00	.00
3C.*	20.00	.525	16.44	-3.967	3.86	-3.41	.638	7.09	.91	.00	.00
4C.*	20.00	.523	16.65	-4.124	3.60	-3.28	.653	7.23	.78	.00	.00
5C	20.00	.526	17.01	-4.583	3.05	-2.22	.668	7.44	1.04	.00	.00
6C.*	19.70	.522	15.84	-3.545	4.73	-5.74	.636	6.91	1.04	.00	.00
7C.*	19.70	.522	16.21	-3.875	4.01	-4.44	.652	7.09	.91	.00	.00
8C	20.10	.527	17.73	-5.688	2.21	-.72	.698	7.82	1.30	.00	.00
9C	20.40	.528	17.77	-5.228	2.49	-1.19	.687	7.83	1.04	.00	.00
1S	21.20	.533	17.62	-4.221	3.4	-2.14	.638	7.63	1.04	.00	.00
2S	20.50	.529	17.85	-5.180	2.53	-1.37	.689	7.91	1.17	.00	.00
3S.*	20.00	.522	16.03	-3.520	4.77	-5.62	.632	6.97	.65	.00	.00
4S	20.30	.526	18.04	-6.004	2.04	-.35	.703	7.94	1.04	.00	.00
5S.*	20.10	.522	15.98	-3.436	4.99	-5.85	.624	6.92	.65	.00	.00
1T.*	18.60	.496	13.25	-2.911	6.86	-6.32	.514	5.01	.26	.00	.00
2T.*	18.20	.483	12.54	-3.615	4.29	4.22	.428	3.98	1.04	.00	.00
3T.*	17.20	.435	10.65	-4.176	3.01	10.90	.346	2.74	.13	.00	.00
4T.*	16.70	.489	11.67	-3.502	4.71	2.45	.448	3.87	.13	.00	.00
5T.*	16.20	.344	9.68	-15.520	.42	16.43	.304	1.79	.13	.00	.00
6T.*	19.00	.509	14.88	-3.504	4.75	-4.22	.589	6.03	.39	.00	.00

AVERAGES: 80927 BASELINE W117 00 000

	22.53	.558	20.54	-7.090	1.71	-.21	.742	9.86	4.81	.00	.00
STD	.09	.000	.07	.101	.03	.09	.001	.04	.64	*	*

80927 W135FE005 (7.2E14)

	20.42	.528	17.67	-5.151	2.63	-1.33	.681	7.76	1.11	.00	.00
STD	.39	.002	.32	.607	.50	.69	.022	.18	.10	*	*

PERCENT OF BASELINE

	90.6	94.7	86.0	127.4	154	*****	91.7	78.7	23.0	*****	*****
STD%	2.1	.5	1.9	9.7	32	768.8	3.0	2.1	5.4	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

80928 W136FE006 (2.4E14) W117 00 000  
 \*COL10 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.562	19.71	-6.236	2.06	-1.10	.737	9.59	.00	.00	.00
1B	22.60	.560	20.73	-7.478	1.60	-.16	.753	10.07	4.55	.00	.00
2B	22.40	.557	20.61	-7.707	1.54	-.08	.756	9.98	4.55	.00	.00
3B	22.80	.559	20.95	-7.553	1.58	-.20	.756	10.19	4.68	.00	.00
4B	22.40	.558	20.62	-7.819	1.51	.10	.753	9.95	5.46	.00	.00
5B	22.70	.560	20.51	-6.648	1.87	-.24	.728	9.79	5.46	.00	.00
1C	21.40	.548	18.87	-5.413	2.45	-1.62	.712	8.84	1.69	.00	.00
2C	19.10	.529	17.24	-6.635	1.80	-.36	.727	7.77	.78	.00	.00
3C	21.20	.548	19.09	-6.423	1.93	-.54	.727	8.94	1.56	.00	.00
4C	19.70	.535	17.84	-6.791	1.76	-.29	.732	8.17	.91	.00	.00
5C	20.00	.538	18.05	-6.539	1.86	-.62	.733	8.34	.98	.00	.00
6C	19.50	.532	17.54	-6.446	1.88	-.51	.725	7.95	.78	.00	.00
7C	19.70	.536	17.84	-6.758	1.77	-.44	.735	8.21	.51	.00	.00
8C	19.80	.534	17.76	-6.257	1.96	-.67	.723	8.08	.91	.00	.00
9C	19.60	.533	17.80	-6.937	1.70	-.27	.736	8.11	.41	.00	.00
10C	21.20	.543	19.08	-6.444	1.90	-.42	.724	8.11	1.53	.00	.00
1S	19.60	.535	17.77	-6.842	1.74	-.35	.735	8.16	1.56	.00	.00
2S	20.00	.537	18.08	-6.602	1.83	-.64	.736	8.36	.91	.00	.00
3S	19.90	.534	17.81	-6.135	2.01	-.83	.722	8.11	.91	.00	.00
4S	21.20	.542	19.33	-7.162	1.65	-.17	.742	9.02	1.56	.00	.00
5S	20.40	.538	18.50	-5.774	1.77	-.46	.737	8.56	1.17	.00	.00
1T	19.90	.529	16.93	-4.631	3.02	-2.01	.666	7.41	.39	.00	.00
2T	19.30	.531	17.29	-6.268	1.95	-.54	.718	7.78	.65	.00	.00
3T	19.50	.529	17.41	-6.140	1.99	-.56	.714	7.79	.65	.00	.00
4T	20.00	.536	18.06	-6.663	1.80	-.28	.727	8.24	1.04	.00	.00
5T	19.90	.531	17.86	-6.267	1.93	-.76	.726	8.11	.78	.00	.00
6T	19.90	.531	17.90	-6.371	1.90	-.67	.728	8.13	.98	.00	.00
AVERAGES: 80928 BASELINE W117 00 000											
	22.58	.559	20.68	-7.441	1.62	-.12	.749	10.00	4.94	.00	.00
STD	.16	.001	.15	.414	.15	.12	.011	.13	.43	*	*
80928 W136FE006 (2.4E14)											
	20.04	.536	18.00	-6.405	1.93	-.62	.725	8.23	1.02	.00	.00
STD	.65	.006	.62	.533	.29	.43	.015	.40	.34	*	*
PERCENT OF BASELINE											
	88.7	95.9	87.0	113.	9	119	*****	96.8	82.4	20.7	*****
STD%	3.5	1.2	3.7	12.4	29	*****	3.5	5.2	9.3	*****	*****

TABLE 16 SOLAR CELL I-V DATA (CONT.)

80929 W137TI010 (2.1E14) W117 00 000

\*SOL10 1 / 8 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.561	19.44	-5.550	2.41	-1.80	.727	9.44	.00	.00	.00
1B	22.50	.558	20.51	-6.938	1.76	-.62	.751	9.97	4.55	.00	.00
2B	22.50	.558	20.63	-7.364	1.63	-.37	.756	10.04	4.55	.00	.00
3B.*	22.60	.555	20.12	-5.744	2.26	-1.27	.723	9.59	3.64	.00	.00
4B	22.10	.558	20.23	-7.241	1.67	-.48	.756	9.86	4.55	.00	.00
5B	22.30	.555	20.36	-7.117	1.70	-.35	.748	9.78	3.90	.00	.00
1C	12.30	.467	11.01	-6.753	1.61	.63	.701	4.26	1.04	.00	.00
2C	12.50	.465	11.12	-6.367	1.74	.10	.697	4.28	.91	.00	.00
3C	12.50	.463	11.03	-6.115	1.84	.16	.684	4.19	.91	.00	.00
4C	12.60	.466	11.24	-6.506	1.69	.21	.700	4.35	.78	.00	.00
5C	12.50	.464	11.14	-6.497	1.69	.27	.698	4.28	.91	.00	.00
6C	12.50	.464	11.12	-6.466	1.70	.49	.693	4.25	.91	.00	.00
7C	13.80	.463	11.75	-4.956	2.50	-1.44	.655	4.42	.91	.00	.00
8C	12.90	.467	11.38	-5.993	1.90	-.38	.691	4.40	.78	.00	.00
9C	12.80	.462	11.13	-5.483	2.15	-1.08	.678	4.24	.78	.00	.00
10C	13.00	.458	11.16	-5.107	2.38	-1.62	.666	4.19	.65	.00	.00
11C	12.60	.464	10.90	-5.311	2.27	-1.48	.675	4.17	.78	.00	.00
1S	12.70	.466	11.36	-6.566	1.67	.12	.705	4.41	.91	.00	.00
2S	12.60	.467	10.85	-5.194	2.37	-1.70	.671	4.18	.65	.00	.00
3S	12.6	.466	10.91	-5.295	2.29	-1.79	.680	4.22	.91	.00	.00
4S	12.90	.467	11.34	-5.878	1.96	-.45	.686	4.37	.78	.00	.00
1T	12.30	.460	10.89	-6.270	1.76	.37	.687	4.11	.91	.00	.00
2T	12.50	.464	11.12	-6.411	1.72	.29	.694	4.26	.91	.00	.00
3T	11.90	.452	10.48	-6.052	1.83	.02	.683	3.89	.91	.00	.00
4T	12.30	.462	10.97	-6.565	1.66	.47	.697	4.19	.91	.00	.00
5T	12.80	.460	11.15	-5.611	2.07	-.58	.675	4.20	.65	.00	.00
AVERAGES: 80929 BASELINE W117 00 000											
	22.35	.557	20.43	-7.165	1.69	-.46	.753	9.91	4.39	.00	.00
STD	.17	.001	.15	.158	.05	.11	.004	.10	.28	*	*
80929 W137TI010 (2.1E14)											
	12.63	.463	11.10	-5.970	1.94	-.37	.686	4.24	.85	.00	.00
STD	.36	.004	.25	.559	.28	.82	.013	.12	.10	*	*
PERCENT OF BASELINE											
	56.5	83.1	54.3	116.7	115	119.0	91.1	42.8	19.3	*****	*****
STDZ	2.1	.8	1.6	9.8	20	240.1	2.1	1.6	3.8	*****	*****



TABLE 16 SOLAR CELL I-V DATA (Cont.)

81002 W138M0005 (1E12) W117 00 000

\*SOL10 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.563	19.81	-6.467	1.96	-.97	.743	9.69	.00	.00	.00
1B	22.30	.561	20.51	-7.713	1.55	-.06	.756	10.00	4.57	.00	.00
2B.*	22.60	.555	19.98	-5.566	2.36	-1.13	.709	9.41	3.00	.00	.00
3B	22.50	.559	20.46	-6.831	1.80	-.56	.745	9.91	4.42	.00	.00
4B.*	22.60	.556	20.06	-5.702	2.29	-1.12	.716	9.51	3.38	.00	.00
5B	22.60	.558	20.67	-7.312	1.65	-.11	.746	9.95	4.68	.00	.00
1C	20.50	.531	18.53	-6.699	1.77	-.23	.728	8.38	1.30	.00	.00
2C	20.60	.529	18.65	-6.665	1.77	-.57	.737	8.50	1.30	.00	.00
4C	20.50	.527	18.28	-5.950	2.07	-.92	.718	8.20	.39	.00	.00
5C	20.50	.527	18.36	-6.244	1.93	-.49	.718	8.20	1.04	.00	.00
6C	21.00	.529	18.98	-6.510	1.83	-.78	.739	8.68	1.17	.00	.00
7C	21.00	.527	18.51	-5.857	2.11	.06	.684	8.01	1.17	.00	.00
8C	21.10	.528	17.26	-4.932	2.71	2.66	.561	6.61	.91	.00	.00
9C	20.80	.527	18.50	-5.839	2.12	-.99	.716	8.30	.78	.00	.00
10C	20.90	.528	15.79	-3.895	3.98	2.00	.502	5.86	1.04	.00	.00
11C.*	21.20	.527	17.97	-5.789	2.14	3.16	.588	6.95	.91	.00	.00
1S	20.90	.529	18.85	-6.693	1.76	.06	.719	8.40	1.30	.00	.00
2S	21.0	.529	18.92	-6.463	1.85	-.52	.729	8.56	1.30	.00	.00
3S	20.90	.528	18.63	-6.175	1.96	-.12	.704	8.22	.91	.00	.00
4S	21.40	.529	19.41	-6.876	1.70	-.19	.734	8.78	1.17	.00	.00
5S.*	21.30	.529	18.20	-4.270	3.40	-4.41	.709	8.45	1.04	.00	.00
1T	20.70	.532	18.56	-6.223	1.96	-.70	.724	8.43	1.17	.00	.00
2T	20.50	.529	18.37	-6.229	1.95	-.60	.721	8.26	1.04	.00	.00
3T	20.90	.532	18.78	-6.453	1.86	-.21	.718	8.45	1.17	.00	.00
4T	20.80	.529	18.51	-6.051	2.02	-.35	.706	8.21	1.17	.00	.00
5T	21.00	.531	18.88	-6.570	1.81	.06	.714	8.42	1.10	.00	.00

AVERAGES: 81002 BASELINE W117 00 000

	22.47	.559	20.55	-7.285	1.66	-.24	.749	9.95	4.51	.00	.00
STD	.12	.001	.09	.361	.11	.23	.005	.03	.12	*	*
	81002 W138M0005 (1E12)										
	20.83	.529	18.43	-6.129	2.06	-.10	.698	8.14	1.08	.00	.00
STD	.24	.002	.77	.695	.51	.92	.061	.71	.22	*	*
PERCENT OF BASELINE											
	92.7	94.6	89.7	115.9	124	158.5	93.3	81.8	24.0	*****	*****
STDZ	1.6	.5	4.1	14.2	41	770.8	8.8	7.4	5.7	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

81003 W139M0006 (4.2E12) W117 00 000

\*SOL10 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IF	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.560	19.66	-6.042	2.13	-1.34	.737	9.56	.00	.00	.00
1B	22.00	.550	19.99	-6.838	1.77	-.45	.741	9.49	5.20	.00	.00
2B	22.00	.552	19.95	-6.710	1.83	-.56	.740	9.50	5.20	.00	.00
3B	22.10	.548	19.79	-6.061	2.08	-.96	.727	9.31	4.55	.00	.00
4B*	21.80	.548	19.58	-6.220	2.01	-.79	.728	9.20	4.94	.00	.00
1C	18.80	.513	16.96	-6.690	1.73	-.17	.724	7.38	.78	.00	.00
2C.*	17.30	.488	12.88	-3.127	5.89	-6.48	.553	4.94	1.43	.00	.00
3C	18.60	.505	16.25	-5.558	2.20	-.30	.677	6.72	.78	.00	.00
4C	18.50	.508	16.48	-6.204	1.90	-.11	.702	6.98	.13	.00	.00
5C.*	16.60	.474	11.46	-3.351	5.00	1.38	.445	3.70	.65	.00	.00
6C	18.80	.509	16.66	-5.945	2.02	-.38	.699	7.07	.65	.00	.00
7C	18.60	.507	16.55	-6.088	1.94	-.40	.706	7.04	.65	.00	.00
8C	17.90	.500	14.89	-4.398	3.15	-1.74	.632	5.98	.39	.00	.00
9C.*	17.90	.498	14.16	-3.592	4.49	-4.51	.602	5.67	.33	.00	.00
10C	18.60	.510	16.69	-6.479	1.79	-.11	.714	7.16	.78	.00	.00
11C	18.70	.509	16.75	-6.509	1.78	.22	.705	7.10	.65	.00	.00
1S	18.60	.512	16.85	-7.034	1.61	.26	.722	7.27	.91	.00	.00
2S	19.10	.512	17.00	-6.164	1.92	-.10	.701	7.25	.91	.00	.00
3S	18.90	.510	16.50	-5.274	2.40	-1.44	.693	7.07	.65	.00	.00
4S	19.20	.511	17.09	-6.231	1.89	.09	.698	7.24	.65	.00	.00
5S	18.50	.507	16.20	-5.409	2.30	-1.21	.694	6.88	.65	.00	.00
6S	19.00	.512	17.06	-6.421	1.82	-.32	.718	7.39	.91	.00	.00
1T.*	17.60	.498	13.85	-3.644	4.39	-3.60	.587	5.44	.30	.00	.00
2T.*	17.60	.499	14.21	-3.859	3.95	-3.53	.615	5.71	.39	.00	.00
3T	15.60	.488	12.44	-4.002	3.71	-1.82	.583	4.69	.20	.00	.00
4T	17.80	.499	15.16	-4.958	2.60	-.59	.647	6.08	.40	.00	.00
5T	18.10	.508	15.95	-5.896	2.04	.03	.684	6.65	.65	.00	.00
6T.*	17.30	.484	11.96	-2.729	7.99	-9.43	.504	4.46	.20	.00	.00
AVERAGES: 81003 BASELINE W117 00 000											
	22.03	.550	19.91	-6.536	1.89	-.65	.736	9.43	4.98	.00	.00
STD	.05	.002	.08	.340	.13	.22	.006	.09	.31	*	*
81003 W139M0006 (4.2E12)											
	18.43	.507	16.20	-5.839	2.17	-.47	.688	6.82	.63	.00	.00
STD	.80	.006	1.12	.791	.53	.65	.035	.66	.22	*	*
PERCENT OF BASELINE											
	83.6	92.2	81.4	110.7	114	127.6	93.5	72.3	12.7	*****	*****
STDZ	3.8	1.4	6.0	17.4	38	155.3	5.7	7.7	5.3	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

81031 W140T1011 (1.8E14) THREE INCH MATERIAL W097 00 000  
 \*SOL10 1 / 8 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.555	19.71	-6.213	2.04	-1.12	.738	9.49	.00	.00	.00
11B	22.80	.553	21.07	-8.153	1.42	.18	.759	10.12	5.20	.00	.00
12B.*	22.30	.546	19.46	-5.145	2.61	-1.51	.696	8.96	2.60	.00	.00
13B	22.20	.551	20.42	-7.672	1.53	-.15	.757	9.80	5.85	.00	.00
14B	22.30	.551	20.46	-7.471	1.58	-.22	.754	9.80	5.60	.00	.00
21B.*	22.40	.548	19.89	-5.751	2.23	-.98	.714	9.27	3.64	.00	.00
22B.*	22.60	.546	19.54	-4.878	2.82	-1.78	.687	8.97	3.00	.00	.00
23B	22.30	.553	20.43	-7.392	1.61	-.20	.751	9.80	3.90	.00	.00
24R	22.10	.553	20.35	-7.801	1.50	-.05	.757	9.79	3.90	.00	.00
31B	22.00	.550	20.27	-7.816	1.49	-.05	.758	9.70	3.64	.00	.00
32B	22.00	.550	20.21	-7.682	1.53	.10	.749	9.59	1.56	.00	.00
33B	22.20	.551	20.31	-7.310	1.63	-.19	.748	9.68	4.55	.00	.00
34B	22.40	.550	20.54	-7.440	1.59	-.21	.753	9.81	4.55	.00	.00
41B	22.00	.553	20.12	-7.308	1.63	-.15	.746	9.60	3.64	.00	.00
42B	22.20	.553	20.50	-8.081	1.44	.13	.759	9.85	4.42	.00	.00
43B	22.10	.555	20.47	-8.332	1.39	.20	.762	9.89	4.68	.00	.00
44B	22.10	.555	20.50	-8.455	1.36	.18	.766	9.94	4.68	.00	.00
51B	22.20	.553	20.62	-8.541	1.34	.17	.768	9.97	5.20	.00	.00
52B	21.90	.556	20.20	-7.877	1.49	-.15	.763	9.82	4.81	.00	.00
11	12.50	.479	11.34	-7.444	1.44	.95	.718	4.55	.91	.00	.00
12	12.50	.477	11.30	-7.154	1.52	.58	.716	4.52	.91	.00	.00
13	12.60	.477	11.37	-7.058	1.54	.56	.714	4.54	.91	.00	.00
14	12.50	.476	11.30	-7.143	1.52	.58	.716	4.51	.91	.00	.00
15	12.60	.476	11.37	-7.047	1.54	.56	.713	4.52	.91	.00	.00
16	12.60	.473	11.30	-6.734	1.63	.39	.705	4.45	.91	.00	.00
17	12.60	.476	11.40	-7.240	1.49	.74	.716	4.54	1.04	.00	.00
18	12.60	.476	11.37	-7.047	1.54	.56	.713	4.52	1.04	.00	.00
19	12.50	.475	11.27	-7.024	1.55	.60	.711	4.47	1.17	.00	.00
110	12.50	.477	11.27	-7.045	1.55	.60	.712	4.49	.91	.00	.00
111	12.10	.475	10.93	-7.191	1.50	.84	.712	4.33	1.04	.00	.00
112	12.10	.477	10.91	-7.071	1.55	.69	.711	4.34	.91	.00	.00
21	12.20	.468	10.77	-6.151	1.85	.25	.684	4.13	.91	.00	.00
22	12.30	.474	10.98	-6.554	1.70	.31	.700	4.32	.91	.00	.00
23	12.30	.474	10.95	-6.477	1.73	.34	.696	4.29	.91	.00	.00
24	12.10	.474	10.97	-7.425	1.44	.94	.717	4.35	.91	.00	.00
25	12.30	.474	11.11	-7.167	1.51	.73	.714	4.40	.91	.00	.00
26	12.10	.474	10.97	-7.425	1.44	.94	.717	4.35	1.04	.00	.00
27	12.30	.474	11.11	-7.167	1.51	.73	.714	4.40	1.04	.00	.00
28	12.30	.473	11.08	-6.996	1.55	.57	.711	4.38	.91	.00	.00
29	12.20	.472	11.02	-7.089	1.52	.47	.716	4.36	1.04	.00	.00
210	12.00	.472	10.89	-7.470	1.42	.93	.719	4.31	1.04	.00	.00
211	11.90	.471	10.78	-7.342	1.45	.87	.716	4.25	.91	.00	.00
212	11.90	.471	10.78	-7.342	1.45	.87	.716	4.25	1.04	.00	.00
31	12.70	.480	11.46	-7.089	1.54	.75	.711	4.58	.91	.00	.00

TABLE 16 SOLAR CELL I-V DATA (Cont.)

32	12.80	.478	11.53	-7.010	1.56	.77	.708	4.58	.91	.00	.00
33	12.60	.478	11.45	-7.557	1.41	1.12	.717	4.57	.91	.00	.00
34	12.50	.475	11.27	-7.024	1.55	.60	.711	4.47	.91	.00	.00
35	12.60	.479	11.35	-7.040	1.56	.77	.708	4.52	.78	.00	.00
36	12.80	.480	11.49	-6.764	1.65	.37	.707	4.60	.91	.00	.00
37	12.70	.478	11.37	-6.637	1.68	.18	.706	4.54	.91	.00	.00
38	12.50	.475	11.21	-6.758	1.63	.45	.705	4.43	1.04	.00	.00
39	12.60	.476	11.33	-6.868	1.60	.38	.711	4.51	1.04	.00	.00
310	12.80	.478	11.51	-6.856	1.61	.36	.711	4.60	.91	.00	.00
311	12.50	.477	11.24	-6.812	1.62	.23	.712	4.49	1.04	.00	.00
312	12.50	.475	11.21	-6.758	1.63	.45	.705	4.43	.78	.00	.00
41	12.00	.470	10.87	-7.356	1.44	.97	.714	4.26	.78	.00	.00
42	12.00	.470	10.82	-7.184	1.49	1.06	.707	4.22	.78	.00	.00
43	12.10	.472	10.87	-6.833	1.60	.36	.709	4.28	1.04	.00	.00
44	12.10	.471	10.92	-7.091	1.52	.65	.712	4.29	.91	.00	.00
45	12.10	.471	10.78	-6.445	1.74	.15	.698	4.21	.78	.00	.00
46	12.00	.471	10.84	-7.171	1.50	.65	.715	4.27	.91	.00	.00
47	12.00	.471	10.82	-7.089	1.52	.70	.712	4.25	.91	.00	.00
48	12.00	.471	10.87	-7.367	1.44	.97	.715	4.27	.91	.00	.00
49	12.00	.469	10.86	-7.232	1.47	.61	.718	4.27	1.04	.00	.00
410	11.90	.469	10.77	-7.319	1.45	.87	.716	4.22	.91	.00	.00
411	11.60	.471	10.47	-7.055	1.54	.42	.716	4.14	.91	.00	.00
412	11.40	.469	10.07	-5.965	1.95	-1.24	.702	3.97	1.04	.00	.00
51	12.10	.478	10.94	-7.224	1.50	.84	.713	4.36	.91	.00	.00
52	12.20	.475	11.01	-7.149	1.52	.87	.710	4.35	1.04	.00	.00
53	12.00	.469	10.62	-6.210	1.83	.00	.691	4.11	.65	.00	.00
54	12.10	.474	10.97	-7.363	1.45	.76	.719	4.36	1.04	.00	.00
55	12.10	.476	10.98	-7.512	1.42	1.13	.716	4.36	2.60	.00	.00
56	11.90	.474	10.83	-7.604	1.39	.95	.723	4.31	.91	.00	.00
57	12.20	.473	11.00	-7.010	1.55	.50	.713	4.35	.91	.00	.00
58	12.30	.473	11.08	-6.996	1.55	.57	.711	4.38	.91	.00	.00
59	12.10	.473	10.97	-7.352	1.45	.76	.719	4.35	.78	.00	.00
510	12.00	.469	10.73	-6.677	1.65	.51	.700	4.17	.78	.00	.00
511	11.80	.470	10.70	-7.517	1.40	1.34	.712	4.18	.78	.00	.00
512	11.80	.469	10.52	-6.451	1.73	-.11	.704	4.12	.78	.00	.00

AVERAGES: 81031 BASELINE W097 00 000											
	22.19	.552	20.43	-7.822	1.50	-.03	.757	9.81	4.41	.00	.00
STD	.21	.002	.22	.398	.09	.16	.006	.13	1.00	*	*
81031 W140T1011 (1.8E14) THREE INCH MATERIAL											
	12.25	.474	11.04	-7.036	1.55	.60	.711	4.37	.95	.00	.00
STD	.31	.003	.29	.348	.11	.37	.007	.14	.23	*	*
PERCENT OF BASELINE											
	55.2	85.8	54.0	110.1	103	*****	94.0	44.5	21.6	*****	*****
STD%	1.9	.8	2.0	9.3	14	*****	1.7	2.1	11.4	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

81109 W141MO/CU001 (4E12-4.4E15) W117 00 000

\*SOL10 1 / 8 / 80 AM1: FO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.561	19.58	-5.858	2.23	-1.54	.734	9.54	.00	.00	.00
2B	22.00	.561	20.30	-7.844	1.51	-.27	.766	10.00	5.20	.00	.00
3B*	22.00	.558	19.50	-6.340	1.99	1.05	.675	8.76	3.90	.00	.00
4B	22.20	.560	20.33	-7.458	1.61	-.01	.747	9.82	5.50	.00	.00
5B*	21.70	.550	19.48	-6.899	1.75	1.16	.691	8.72	3.12	.00	.00
1C	18.60	.505	16.39	-5.713	2.12	-.65	.695	6.91	.78	.00	.00
2C	18.80	.507	16.81	-6.277	1.86	-.32	.712	7.18	.91	.00	.00
3C	18.70	.507	16.81	-6.450	1.79	-.46	.723	7.25	.91	.00	.00
4C	18.90	.508	16.95	-6.429	1.80	-.16	.714	7.25	.91	.00	.00
5C	18.90	.506	16.60	-5.738	2.11	-.16	.683	6.91	.78	.00	.00
6C	19.00	.508	17.00	-6.223	1.88	-.55	.717	7.32	.78	.00	.00
7C	18.90	.505	16.73	-5.906	2.02	-.38	.697	7.04	.78	.00	.00
8C	18.70	.505	16.65	-6.131	1.92	-.32	.706	7.05	.78	.00	.00
9C	18.90	.506	16.93	-6.319	1.84	-.40	.716	7.25	.91	.00	.00
10C	18.80	.507	16.88	-6.497	1.77	-.13	.715	7.21	.78	.00	.00
1S	19.00	.510	17.05	-6.452	1.80	-.20	.716	7.34	.91	.00	.00
2S	18.80	.508	16.70	-5.779	2.09	-1.34	.719	7.26	.91	.00	.00
3S	18.80	.512	16.80	-6.260	1.89	-.30	.711	7.23	.78	.00	.00
4S	18.90	.512	16.92	-6.263	1.88	-.50	.717	7.34	.91	.00	.00
5S	18.90	.511	16.97	-6.295	1.87	-.80	.727	7.43	.91	.00	.00
6S	19.10	.511	17.19	-6.503	1.78	-.38	.723	7.47	.91	.00	.00
1T	17.80	.505	15.45	-5.128	2.50	-1.73	.688	6.54	.78	.00	.00
2T	18.40	.505	16.26	-5.770	2.09	-.76	.701	6.89	.65	.00	.00
3T	18.10	.505	16.17	-6.223	1.88	-.42	.711	6.88	.91	.00	.00
4T	18.30	.507	16.44	-6.537	1.76	-.14	.716	7.03	.91	.00	.00
5T.*	17.90	.499	14.79	-4.035	3.64	-3.94	.648	6.13	.50	.00	.00
6T.*	17.50	.480	12.68	-3.153	5.67	-3.90	.512	4.55	.91	.00	.00
AVERAGES: 81109 BASELINE W117 00 000											
	22.10	.561	20.32	-7.651	1.56	-.14	.756	9.91	5.35	.00	.00
STD	.10	.000	.02	.193	.05	.13	.010	.09	.15	*	*
81109 W141MO/CU001 (4E12-4.4E15)											
	18.72	.507	16.69	-6.145	1.93	-.51	.710	7.14	.85	.00	.00
STD	.32	.002	.38	.354	.17	.40	.012	.22	.08	*	*
PERCENT OF BASELINE											
	84.7	90.5	82.1	119.7	124	*****	93.9	72.0	15.8	*****	*****
STD%	1.8	.5	2.0	6.8	15	856.4	2.8	2.9	1.9	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

81110 W\*143TI002 (2E14) LOW RESISTIVITY W142 00 000  
 \*SOL10 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.561	19.70	-6.173	2.08	-1.20	.738	9.60	.00	.00	.00
581B*	20.10	.594	16.27	-4.729	3.27	2.84	.554	7.00	.91	.00	.00
582B*	20.10	.571	16.54	-4.218	3.78	-1.67	.617	7.49	.78	.00	.00
583B*	20.00	.565	14.55	-4.621	3.23	7.97	.438	5.23	.65	.00	.00
585B.*	20.30	.598	18.26	-6.253	2.19	-1.13	.734	9.42	1.69	.00	.00
1421B	20.50	.600	18.96	-8.089	1.57	-.13	.766	9.97	1.95	.00	.00
1422B.*	20.30	.590	17.80	-5.390	2.67	-1.39	.698	8.84	1.04	.00	.00
1423B*	20.30	.546	16.54	-4.400	3.37	.39	.585	6.86	.39	.00	.00
1424B.*	20.70	.589	18.22	-5.510	2.57	-1.22	.701	9.04	1.17	.00	.00
1425B	20.30	.595	18.34	-6.510	2.06	-.86	.737	9.42	1.69	.00	.00
1C	10.90	.529	9.76	-6.482	1.96	-1.09	.719	4.39	.91	.00	.00
2C	11.00	.528	9.94	-6.955	1.77	-.47	.728	4.47	1.04	.00	.00
3C	10.70	.532	9.90	-8.413	1.38	-.11	.765	4.61	.78	.00	.00
4C	11.00	.535	10.24	-8.993	1.27	.19	.774	4.82	.91	.00	.00
5C	10.90	.523	9.51	-5.538	2.44	-2.22	.689	4.16	.65	.00	.00
6C	11.10	.533	10.13	-7.462	1.62	-.33	.743	4.65	1.17	.00	.00
7C	11.30	.531	10.27	-7.233	1.68	-.38	.737	4.67	1.17	.00	.00
8C	10.80	.484	8.85	-4.627	3.04	-.61	.600	3.32	.78	.00	.00
9C	10.60	.534	9.94	-10.010	1.11	.82	.783	4.68	1.04	.00	.00
10C.*	10.90	.508	8.60	-3.856	4.47	-6.21	.591	3.46	.65	.00	.00
1S	10.80	.535	9.99	-8.656	1.34	.75	.756	4.62	.91	.00	.00
2S	10.80	.514	9.21	-5.118	2.72	-1.66	.653	3.83	.56	.00	.00
3S	10.90	.538	10.25	-10.225	1.09	.62	.790	4.90	1.30	.00	.00
4S	11.10	.538	10.42	-10.024	1.11	.64	.786	4.96	1.56	.00	.00
5S	11.20	.535	10.37	-8.525	1.36	.17	.764	4.84	1.17	.00	.00
6S	11.00	.532	10.10	-7.907	1.49	-.13	.753	4.66	1.69	.00	.00
1T	10.60	.531	9.78	-8.265	1.41	-.15	.762	4.54	1.43	.00	.00
2T.*	10.80	.516	8.95	-4.463	3.45	-4.31	.636	3.75	.91	.00	.00
3T	10.80	.527	9.63	-6.330	2.02	-1.11	.712	4.29	1.04	.00	.00
4T	10.80	.459	8.67	-4.456	3.08	.18	.573	3.00	.65	.00	.00
5T	10.90	.535	10.08	-8.453	1.38	.05	.764	4.71	1.17	.00	.00
6T	10.80	.526	9.59	-6.111	2.12	-1.64	.711	4.27	1.30	.00	.00
AVERAGES: 81110 BASELINE W142 00 000											
	20.40	.598	18.65	-7.299	1.81	-.50	.752	9.69	1.82	.00	.00
STD	.10	.002	.31	.790	.25	.37	.015	.28	.13	*	*
81110 W*143TI002 (2E14) LOW RESISTIVITY											
	10.90	.525	9.83	-7.489	1.77	-.32	.728	4.42	1.06	.00	.00
STD	.18	.019	.47	1.717	.61	.83	.058	.50	.30	*	*
PERCENT OF BASELINE											
	53.4	87.9	52.7	97.4	97	134.8	96.9	45.6	58.3	*****	*****
STDZ	1.1	3.6	3.4	37.2	51	338.4	9.7	6.6	21.6	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

81130 W144M0001 (4.4E12) LOW RESISTIVITY W142 00 000  
 \*SOL10 1 / 8 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.559	19.83	-6.532	1.92	-.89	.744	9.63	.00	.00	.00
1B	20.40	.595	18.85	-8.047	1.56	-.15	.766	9.83	1.69	.00	.00
2B	20.40	.595	18.96	-8.510	1.46	-.08	.775	9.95	1.69	.00	.00
3B.*	20.40	.583	17.95	-5.503	2.55	-1.26	.702	8.82	.91	.00	.00
4B.*	20.40	.564	17.20	-4.688	3.14	-.78	.637	7.75	.65	.00	.00
5B.*	20.40	.576	17.43	-4.730	3.17	-1.87	.667	8.29	.85	.00	.00
1C	17.40	.575	15.83	-6.938	1.85	-.91	.749	7.92	1.17	.00	.00
2C	16.60	.538	12.75	-4.079	3.91	2.12	.518	4.89	.52	.00	.00
3C*	11.10	.165	7.74	-10.903	.31	8.85	.367	.71	.00	.00	.00
4C	17.30	.525	14.16	-4.380	3.35	-.58	.600	5.76	.52	.00	.00
5C	17.60	.560	15.15	-4.916	2.96	-2.22	.679	7.08	.80	.00	.00
6C.*	13.30	.186	9.67	-6.483	.67	6.02	.411	1.07	.00	.00	.00
7C.*	13.10	.176	9.66	-7.631	.51	6.25	.410	1.00	.00	.00	.00
8C.*	12.30	.154	9.49	-13.559	.22	6.64	.413	.83	.00	.00	.00
9C	17.60	.558	15.18	-5.033	2.84	-1.76	.677	7.03	.65	.00	.00
10C.*	16.70	.556	13.28	-3.510	5.34	-7.66	.626	6.15	.78	.00	.00
11C.*	15.10	.246	10.95	-5.853	1.02	6.48	.415	1.63	.00	.00	.00
1S	17.70	.531	15.10	-5.085	2.66	-.11	.643	6.39	.52	.00	.00
2S	17.40	.563	15.01	-5.069	2.84	-1.59	.675	6.99	.72	.00	.00
3S	17.50	.577	16.33	-9.088	1.31	.19	.779	8.31	1.04	.00	.00
4S	17.60	.577	16.25	-8.172	1.50	.23	.757	8.13	1.17	.00	.00
5S	17.40	.563	14.74	-4.626	3.28	-2.34	.658	6.82	.65	.00	.00
6S	17.30	.569	15.25	-5.794	2.36	-.58	.693	7.21	1.04	.00	.00

>ALL TANG SAMPLES TESTED TOO POORLY TO MEASURE

AVERAGES: 81130 BASELINE W142 00 000

	20.40	.595	18.91	-8.278	1.51	-.12	.770	9.89	1.69	.00	.00
STD	.00	.000	.05	.232	.05	.04	.005	.06	.00	*	*

81130 W144M0001 (4.4E12) LOW RESISTIVITY

	17.40	.558	15.07	-5.744	2.62	-.69	.675	6.96	.80	.00	.00
STD	.28	.018	.95	1.551	.77	1.24	.071	.97	.25	*	*

PERCENT OF BASELINE

	85.3	93.8	79.7	130.6	174	*****	87.6	70.4	47.3	*****	*****
STD%	1.4	3.0	5.3	21.2	59	*****	9.7	10.3	14.7	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

81201 W145W001 (8.5E11) W097 00 000

\*SOL11 1 / 8 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.559	19.83	-6.532	1.92	-.89	.744	9.63	.00	.00	.00
1B	22.10	.553	20.51	-8.505	1.35	.17	.767	9.92	5.20	.00	.00
2B	22.10	.558	19.91	-6.275	2.02	-1.02	.738	9.62	4.16	.00	.00
3B	22.10	.557	19.91	-6.267	2.02	-1.02	.738	9.60	5.20	.00	.00
4B	22.10	.558	19.88	-6.217	2.04	-1.00	.735	9.58	4.81	.00	.00
5B	22.00	.558	19.82	-6.287	2.01	-.98	.737	9.57	3.90	.00	.00
1C	21.10	.536	19.03	-6.460	1.87	-.64	.732	8.76	1.69	.00	.00
2C	21.00	.537	18.01	-5.821	2.16	2.43	.612	7.30	1.56	.00	.00
3C	21.40	.531	18.55	-5.026	2.64	-1.47	.685	8.23	1.04	.00	.00
4C	21.10	.539	19.23	-7.056	1.67	-.33	.744	8.94	1.82	.00	.00
5C	21.20	.539	19.34	-7.315	1.60	.14	.737	8.90	2.21	.00	.00
6C	21.00	.534	18.73	-5.910	2.11	-1.04	.721	8.55	1.69	.00	.00
7C	21.40	.535	18.63	-5.066	2.63	-1.73	.695	8.42	1.43	.00	.00
8C	21.10	.530	18.22	-4.885	2.76	-1.84	.686	8.11	1.04	.00	.00
9C	21.10	.541	19.28	-7.262	1.62	-.21	.747	9.01	2.34	.00	.00
10C	21.10	.541	19.16	-6.991	1.70	-.03	.732	8.84	2.21	.00	.00
1S*	17.20	.540	10.86	-11.275	.95	21.77	.326	3.20	1.95	.00	.00
2S	21.20	.538	18.94	-6.002	2.08	-.95	.723	8.72	1.95	.00	.00
3S	21.30	.539	19.23	-6.670	1.80	-.15	.725	8.80	2.34	.00	.00
4S	21.30	.539	19.28	-6.637	1.81	-.59	.738	8.96	2.34	.00	.00
5S	21.30	.538	19.07	-6.084	2.04	-.90	.725	8.79	2.21	.00	.00
6S	21.10	.536	18.75	-5.772	2.19	-1.14	.717	8.58	1.82	.00	.00
1T	21.00	.538	18.55	-5.930	2.11	.09	.687	8.21	1.82	.00	.00
2T	21.00	.537	18.96	-6.577	1.83	-.45	.730	8.71	2.21	.00	.00
3T	21.10	.537	18.96	-6.316	1.93	-.62	.726	8.70	2.34	.00	.00
4T	21.00	.536	18.89	-6.338	1.92	-.70	.729	8.68	2.34	.00	.00
5T	21.10	.536	19.10	-6.749	1.76	-.28	.732	8.75	1.95	.00	.00
6T	21.40	.538	19.38	-6.805	1.75	-.15	.730	8.89	2.34	.00	.00
AVERAGES: 81201 BASELINE W097 00 000											
	22.08	.557	20.01	-6.710	1.89	-.77	.743	9.66	4.65	.00	.00
STD	.04	.002	.26	.898	.27	.47	.012	.13	.54	*	*
81201 W145W001 (8.5E11)											
	21.16	.537	18.92	-6.270	2.00	-.50	.717	8.61	1.94	.00	.00
STD	.14	.003	.36	.686	.33	.86	.029	.38	.40	*	*
PERCENT OF BASELINE											
	95.8	96.4	94.6	106.6	106	134.7	96.5	89.2	41.6	*****	*****
STDZ	.8	.8	3.0	24.1	35	219.3	5.6	5.2	14.5	*****	*****



TABLE 16 SOLAR CELL I-V DATA (Cont.)

81204 W146C0001 (3E15) W117 00 000

\*SOL11 1 / 9 / 80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.556	19.64	-6.031	2.12	-1.25	.734	9.45	.00	.00	.00
1B	22.00	.552	20.21	-7.563	1.56	-.17	.755	9.69	5.20	.00	.00
2B	21.90	.549	19.94	-6.978	1.72	-.39	.744	9.46	4.55	.00	.00
3B.*	22.10	.549	19.75	-5.979	2.12	-.98	.724	9.29	4.16	.00	.00
4B	22.30	.551	20.26	-6.874	1.76	-.34	.739	9.61	4.94	.00	.00
5B	22.60	.550	20.66	-7.254	1.64	-.23	.748	9.83	5.20	.00	.00
1C	20.60	.530	17.83	-5.052	2.63	-1.30	.679	7.85	1.30	.00	.00
2C	20.50	.528	18.34	-6.253	1.93	-.32	.713	8.16	1.60	.00	.00
3C	20.90	.527	17.81	-4.668	2.95	-1.72	.665	7.74	1.17	.00	.00
4C.*	22.00	.540	17.71	-3.550	4.75	-4.87	.633	7.95	2.34	.00	.00
5C	21.00	.531	18.25	-5.227	2.50	-.88	.679	8.01	1.69	.00	.00
6C	21.90	.541	18.33	-4.178	3.59	-2.90	.658	8.24	2.60	.00	.00
7C	21.40	.540	19.19	-6.272	1.96	-.48	.720	8.80	2.60	.00	.00
8C.*	21.90	.536	16.08	-2.769	7.84	-9.22	.567	7.04	1.56	.00	.00
9C	20.80	.531	17.48	-4.261	3.44	-2.96	.663	7.74	1.43	.00	.00
10C.*	18.40	.501	14.34	-3.383	5.05	-5.59	.596	5.81	.33	.00	.00
11C.*	21.50	.538	17.85	-3.922	3.98	-4.29	.665	8.13	2.34	.00	.00
1S.*	21.60	.538	17.70	-3.785	4.23	-4.22	.646	7.94	2.08	.00	.00
2S.*	21.90	.543	18.00	-3.855	4.13	-3.82	.646	8.12	2.60	.00	.00
3S.*	21.90	.543	17.74	-3.558	4.76	-5.39	.646	8.12	3.00	.00	.00
4S.*	22.20	.541	17.63	-3.306	5.44	-6.44	.633	8.04	2.34	.00	.00
5S	21.80	.538	18.73	-4.730	2.93	-2.04	.682	8.46	2.60	.00	.00
1T.*	19.40	.514	15.16	-3.358	5.19	-5.69	.601	6.34	.52	.00	.00
2T.*	19.50	.508	14.28	-3.095	6.05	-4.53	.527	5.52	.26	.00	.00
3T	21.20	.536	18.76	-5.756	2.19	-.66	.702	8.43	2.47	.00	.00
4T.*	21.60	.533	16.60	-3.126	6.04	-6.57	.595	7.24	1.30	.00	.00
5T	21.50	.537	19.13	-5.984	2.08	-.50	.708	8.65	2.60	.00	.00
6T	21.00	.531	19.06	-4.864	2.78	-1.55	.675	7.96	1.69	.00	.00
AVERAGES: 81204 BASELINE W117 00 000											
	22.20	.551	20.27	-7.167	1.67	-.28	.747	9.65	4.97	.00	.00
STD	.27	.001	.26	.267	.08	.09	.006	.14	.27	*	*
81204 W146C0001 (3E15)											
	21.15	.534	18.36	-5.204	2.63	-1.39	.686	8.19	1.98	.00	.00
STD	.44	.005	.53	.723	.54	.90	.021	.35	.56	*	*
PERCENT OF BASELINE											
	95.2	96.9	90.6	127.4	158	*****	91.9	84.8	39.8	*****	*****
STD%	3.2	1.0	3.8	13.2	41	575.6	3.5	4.8	14.1	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

81206 W147N/N1002 (1.6E15) W097 00 000

\*SOL11 1 / 9 / 80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.560	19.83	-6.500	1.93	-.99	.746	9.67	.00	.00	.00
1B	22.10	.552	20.27	-7.686	1.53	.32	.742	9.57	7.15	.00	.00
2B	22.00	.554	20.27	-7.965	1.47	.28	.751	9.68	6.50	.00	.00
3B	21.80	.550	19.63	-6.538	1.88	-.16	.721	9.14	4.55	.00	.00
4B	21.90	.541	19.94	-7.315	1.60	.42	.728	9.12	4.90	.00	.00
1C	21.40	.447	17.67	-4.984	2.25	1.92	.574	5.81	.65	.00	.00
2C	21.40	.441	17.69	-4.813	2.34	1.24	.585	5.84	.91	.00	.00
3C	21.90	.463	18.57	-5.153	2.21	.92	.618	6.63	.91	.00	.00
4C	21.40	.414	17.40	-4.380	2.55	.41	.581	5.44	.91	.00	.00
5C	21.90	.457	18.69	-5.605	1.93	1.80	.610	6.46	.91	.00	.00
6C	21.50	.447	17.66	-4.803	2.38	1.56	.575	5.84	.65	.00	.00
7C	22.10	.489	18.24	-4.608	2.77	.64	.594	6.79	.78	.00	.00
8C	21.90	.484	18.28	-4.923	2.48	1.18	.598	6.70	1.04	.00	.00
9C	21.90	.435	17.91	-4.710	2.38	1.43	.571	5.76	.78	.00	.00
10C	22.20	.513	18.97	-5.047	2.53	.01	.643	7.75	1.30	.00	.00
1S	21.60	.435	17.88	-4.667	2.42	.61	.596	5.93	.78	.00	.00
2S	21.70	.454	18.13	-4.919	2.33	1.04	.600	6.25	.43	.00	.00
3S	22.10	.538	19.29	-5.545	2.31	.03	.671	8.44	3.25	.00	.00
4S	21.90	.437	18.14	-4.933	2.23	1.51	.583	5.90	1.04	.00	.00
5S	21.70	.445	18.01	-4.958	2.26	1.53	.585	5.97	.91	.00	.00
1T	21.60	.421	17.96	-5.060	2.07	1.64	.584	5.61	1.04	.00	.00
2T	21.90	.401	18.52	-5.184	1.90	1.01	.611	5.68	1.17	.00	.00
3T	21.70	.418	18.04	-4.897	2.16	1.15	.591	5.67	1.30	.00	.00
4T	22.20	.526	18.90	-4.937	2.63	-.14	.641	7.92	2.08	.00	.00
5T	22.00	.423	18.56	-5.172	2.01	1.18	.606	5.97	.91	.00	.00
AVERAGES: 81206 BASELINE W097 00 000											
	21.95	.549	20.03	-7.376	1.62	.22	.735	9.37	5.78	.00	.00
STD	.11	.005	.26	.536	.16	.22	.012	.25	1.08	*	*
81206 W147N/N1002 (1.6E15)											
	21.80	.454	18.23	-4.965	2.31	1.03	.601	6.32	1.09	.00	.00
STD	.25	.037	.48	.280	.22	.59	.025	.81	.59	*	*
PERCENT OF BASELINE											
	99.3	82.7	91.0	132.7	143	480.0	81.7	67.4	18.8	*****	*****
STDZ	1.7	7.5	3.6	9.0	29	*****	4.8	10.7	15.7	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90417 W148N/MN002 (6E14) W079 00 000  
 \*SOL12 1 /10/80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCDa	PCDb
2R.*	21.90	.557	19.72	-6.265	2.02	-1.02	.737	9.51	.00	.00	.00
1B	21.50	.540	19.29	-6.561	1.84	.32	.706	8.67	4.60	.00	.00
2B*	21.20	.535	18.77	-6.222	1.96	.82	.677	8.12	4.29	.00	.00
3B.*	21.20	.540	18.47	-5.706	2.24	.75	.57	7.95	3.00	.00	.00
4B	21.80	.543	19.48	-6.475	1.88	.54	.696	8.71	4.68	.00	.00
5B*	21.40	.505	17.38	-4.304	3.20	.15	.584	6.68	.78	.00	.00
1C	21.10	.524	17.70	-4.442	3.16	-1.55	.642	7.51	1.30	.00	.00
2C	20.90	.507	16.91	-4.253	3.29	.10	.580	6.50	.72	.00	.00
3C	21.10	.537	18.58	-5.432	2.39	-1.42	.707	8.48	3.25	.00	.00
4C	20.90	.539	18.60	-5.849	2.16	-1.03	.717	8.54	1.56	.00	.00
5C	21.40	.521	18.09	-5.107	2.53	1.08	.614	7.24	3.00	.00	.00
7C	21.50	.554	17.32	-3.922	4.10	-1.79	.597	7.52	5.20	.00	.00
8C	21.20	.493	17.20	-4.418	3.00	.80	.575	6.35	.78	.00	.00
9C	21.00	.543	18.42	-5.297	2.51	-1.57	.703	8.48	3.51	.00	.00
10C	21.30	.541	18.39	-4.870	2.83	-1.87	.685	8.35	3.25	.00	.00
1S	21.00	.550	18.90	-6.381	1.95	-.63	.728	8.89	5.20	.00	.00
2S	21.10	.534	18.28	-5.089	2.61	-1.18	.680	8.10	2.60	.00	.00
3S	21.00	.538	18.69	-6.007	2.08	-.47	.707	8.45	4.16	.00	.00
4S	21.00	.543	19.07	-7.070	1.68	.14	.729	8.79	4.55	.00	.00
5S	21.30	.546	18.90	-5.707	2.26	-1.22	.716	8.81	4.16	.00	.00
1T.*	17.30	.532	11.22	-4.983	2.76	14.46	.359	3.50	1.69	.00	.00
2T.*	17.00	.548	10.71	-5.697	2.33	17.96	.340	3.35	2.90	.00	.00
3T.*	16.50	.541	10.64	-4.835	2.96	15.10	.358	3.38	2.34	.00	.00
4T.*	16.50	.551	10.69	-5.468	2.50	17.02	.354	3.41	3.00	.00	.00
5T	21.40	.556	17.69	-4.527	3.25	.13	.603	7.59	3.00	.00	.00
AVERAGES: 90417 BASELINE W079 00 000											
	21.65	.542	19.39	-6.518	1.86	.43	.701	8.69	4.64	.00	.00
STD	.15	.002	.10	.043	.02	.11	.005	.02	.04	*	*
90417 W148N/MN002 (6E14)											
	21.15	.535	18.18	-5.225	2.65	-.70	.666	7.97	3.08	.00	.00
STD	.19	.017	.65	.840	.61	.92	.055	.79	1.42	*	*
PERCENT OF BASELINE											
	97.7	98.8	93.8	119.8	142	*****	95.0	91.8	65.4	*****	*****
STD%	1.5	3.4	3.8	13.5	35	310.3	8.6	9.3	31.5	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90418 W149N/FE003 (6E14) W079 00 000

\*SOL12 1 /10/80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.559	19.50	-5.684	2.32	-1.64	.729	9.44	.00	.00	.00
1B*	16.70	.489	12.35	-4.289	3.25	5.46	.466	4.02	.00	.00	.00
2B*	19.90	.524	14.99	-3.207	5.76	-4.77	.555	6.12	.00	.00	.00
3B	21.10	.543	18.89	-6.381	1.93	.05	.707	8.57	3.25	.00	.00
4B*	18.60	.400	12.48	-6.974	1.27	11.85	.361	2.84	.00	.00	.00
5B	21.30	.558	19.26	-6.578	1.90	-.62	.736	9.25	5.20	.00	.00
1C	20.90	.543	18.05	-5.024	2.71	-1.24	.676	8.11	1.56	.00	.00
2C	20.90	.535	18.09	-5.352	2.43	.00	.660	7.81	1.69	.00	.00
3C	20.50	.531	17.65	-5.137	2.57	-.43	.659	7.59	1.56	.00	.00
4C	20.80	.526	17.90	-5.246	2.47	.14	.650	7.52	1.56	.00	.00
5C	20.70	.521	17.64	-5.026	2.60	.06	.639	7.28	1.69	.00	.00
6C	20.80	.532	17.87	-5.046	2.64	-.60	.659	7.71	1.56	.00	.00
7C	20.70	.531	17.81	-5.195	2.53	-.10	.654	7.60	1.56	.00	.00
8C	20.70	.535	18.07	-5.490	2.35	-.30	.676	7.92	2.21	.00	.00
9C	20.80	.517	17.09	-4.318	3.28	-.65	.606	6.89	1.04	.00	.00
10C	21.00	.516	18.16	-5.352	2.35	.13	.656	7.52	1.82	.00	.00
11C	21.10	.541	18.73	-5.897	2.14	-.54	.705	8.51	2.34	.00	.00
1S	20.60	.495	16.39	-4.069	3.47	.02	.565	6.09	.78	.00	.00
2S	20.80	.527	17.77	-5.033	2.63	-.16	.646	7.49	2.08	.00	.00
3S	20.70	.517	17.16	-4.524	3.04	-.17	.610	6.90	1.30	.00	.00
4S	21.20	.542	18.20	-4.759	2.93	-1.90	.677	8.23	1.82	.00	.00
5S	20.70	.531	17.91	-5.348	2.42	.04	.658	7.65	2.08	.00	.00
1T	20.50	.537	17.50	-4.861	2.83	-.96	.656	7.63	2.21	.00	.00
2T	21.20	.556	19.11	-6.449	1.94	-.61	.730	9.10	4.42	.00	.00
3T	20.50	.521	17.00	-4.491	3.10	-.42	.614	6.93	1.04	.00	.00
4T	20.60	.536	17.91	-5.370	2.43	-.39	.672	7.85	2.34	.00	.00
5T	20.60	.527	17.54	-4.967	2.68	-.17	.641	7.36	1.69	.00	.00
AVERAGES: 90418 BASELINE W079 00 000											
	21.20	.551	19.07	-6.480	1.91	-.28	.722	8.91	4.23	.00	.00
STD	.10	.007	.18	.098	.01	.33	.014	.34	.97	*	*
90418 W149N/FE003 (6E14)											
	20.78	.529	17.79	-5.093	2.64	-.39	.653	7.60	1.83	.00	.00
STD	.21	.012	.57	.511	.36	.49	.034	.61	.71	*	*
PERCENT OF BASELINE											
	98.0	96.2	93.3	121.4	138	61.7	90.5	85.4	43.2	*****	*****
STD%	1.4	3.6	3.9	9.2	20	536.4	6.6	10.4	30.8	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90109 W150-N/V-003 (3E13) W079 00 000

\*SH2 1 /28/80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.561	19.81	-6.469	1.95	-.05	.743	9.66	.00	.00	.00
>079 N BASE											
1B	22.20	.556	19.98	-6.443	1.94	-.32	.722	9.43	4.68	.00	.00
2B.*	22.40	.553	19.72	-5.512	2.39	-.91	.699	9.15	5.72	.00	.00
3B.*	22.40	.556	19.64	-5.381	2.49	-1.03	.695	9.15	4.42	.00	.00
4B	22.40	.557	20.37	-7.070	1.72	.02	.734	9.68	8.58	.00	.00
5B*	22.40	.551	19.22	-4.782	2.94	-1.54	.672	8.77	2.99	.00	.00
6B	22.70	.565	20.72	-7.071	1.74	-.42	.749	10.15	9.10	.00	.00
>150 N/V 003 S											
1	20.30	.544	18.71	-7.943	1.45	.05	.757	8.84	3.90	.00	.00
2	20.20	.537	18.31	-6.928	1.71	-.01	.729	8.36	3.90	.00	.00
3	20.40	.539	18.29	-6.241	1.98	-.65	.722	8.40	3.90	.00	.00
4	20.00	.537	18.31	-7.560	1.53	.24	.740	8.41	4.16	.00	.00
5	20.30	.541	18.68	-7.880	1.46	.18	.751	8.72	4.16	.00	.00
6	20.20	.541	18.40	-7.027	1.69	-.42	.744	8.60	2.34	.00	.00
>150 N/V 003 T											
1	20.50	.532	18.02	-5.566	2.29	-.73	.693	7.99	2.08	.00	.00
2	20.00	.542	17.95	-6.181	2.02	-1.02	.730	8.36	2.34	.00	.00
3	20.20	.538	18.23	-6.576	1.84	-.48	.730	8.39	2.86	.00	.00
4	19.90	.544	18.23	-7.383	1.60	-.35	.753	8.63	3.12	.00	.00
5	20.50	.536	18.17	-5.811	2.17	-.77	.706	8.21	1.56	.00	.00
6	20.30	.542	18.74	-8.063	1.42	.08	.759	8.83	2.08	.00	.00
2R*	21.90	.560	19.72	-6.246	2.04	-1.07	.738	9.57	.00	.00	.00
>150 N V 003 CTR											
1	20.30	.516	17.37	-4.936	2.66	-.78	.656	7.27	1.82	.00	.00
2	20.20	.535	17.95	-5.890	2.13	-.79	.710	8.12	2.34	.00	.00
3	20.20	.538	18.40	-7.185	1.64	.02	.730	8.46	3.12	.00	.00
4	20.30	.537	18.78	-8.428	1.33	.54	.753	8.68	3.90	.00	.00
5	20.20	.540	18.25	-6.597	1.84	-.55	.733	8.46	3.12	.00	.00
6	19.80	.521	17.68	-6.550	1.80	.75	.691	7.54	2.34	.00	.00
7	20.20	.542	18.62	-7.960	1.44	.12	.755	8.74	3.38	.00	.00
8	20.20	.541	18.12	-6.447	1.90	-.08	.713	8.24	3.12	.00	.00
9	20.40	.532	18.11	-5.918	2.10	-.58	.706	8.10	2.34	.00	.00
10	20.30	.538	18.28	-6.765	1.77	.37	.711	8.21	2.08	.00	.00
AVERAGES: 90109 BASELINE W079 00 000											
	22.43	.559	20.36	-6.862	1.80	-.24	.735	9.75	7.45	.00	.00
STD	.21	.004	.30	.296	.10	.19	.011	.30	1.97	*	*
90109 W150-N/V-003 (3E13)											
	20.22	.537	18.26	-6.811	1.81	-.22	.726	8.34	2.91	.00	.00
STD	.17	.007	.34	.898	.32	.48	.026	.38	.80	*	*
PERCENT OF BASELINE											
	90.1	96.0	89.7	100.7	101	107.4	98.8	85.5	39.0	*****	*****
STD%	1.6	1.9	3.0	17.9	25	433.3	5.0	6.6	23.9	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90125 W152TI001 2.5E14											W151 00 000	
*SH3 1 /28/80 AM1: P0=91.60MW/CM <sup>2</sup>											NO AR COATING	
ID	ISC	VOC	IP	LOG(I <sub>0</sub> )	N	R	FF	Eff	OCD	rCDa	PCDb	
2R*	21.90	.561	19.78	-6.417	1.97	-.94	.740	9.62	.00	.00	.00	
1B	21.80	.504	20.09	-8.134	1.30	.48	.746	8.67	5.33	.00	.00	
2B	21.70	.507	19.96	-7.917	1.35	.36	.746	8.68	4.55	.00	.00	
3B	21.60	.510	19.48	-6.594	1.73	-.19	.724	8.43	4.16	.00	.00	
4B	22.00	.511	19.87	-6.633	1.72	-.21	.726	8.64	5.98	.00	.00	
1C	15.00	.447	12.56	-4.951	2.39	.60	.612	4.34	1.04	.00	.00	
2C	15.10	.446	12.62	-4.867	2.45	.31	.613	4.37	1.04	.00	.00	
3C	15.20	.445	12.65	-4.782	2.51	.22	.609	4.36	.91	.00	.00	
4C	15.30	.447	12.76	-4.850	2.46	.42	.610	4.41	.91	.00	.00	
5C	15.40	.447	12.84	-4.883	2.43	.67	.606	4.41	4.52	.00	.00	
6C	15.20	.439	12.50	-4.710	2.54	.77	.591	4.17	.52	.00	.00	
7C	15.10	.444	12.51	-4.773	2.51	.55	.601	4.26	1.04	.00	.00	
8C	15.00	.433	12.51	-4.627	2.58	-.98	.626	4.30	1.04	.00	.00	
9C	14.90	.442	12.41	-4.907	2.40	.82	.604	4.20	.52	.00	.00	
1S	15.00	.447	12.82	-5.392	2.09	.84	.633	4.49	.45	.00	.00	
2S	15.40	.449	12.84	-4.838	2.48	.37	.610	4.46	.65	.00	.00	
3S	15.10	.445	12.60	-4.831	2.47	.26	.612	4.35	.65	.00	.00	
4S	14.80	.446	12.23	-4.678	2.61	.16	.602	4.20	4.52	.00	.00	
5S	15.00	.448	12.48	-5.146	2.25	2.17	.588	4.18	.78	.00	.00	
1T	14.80	.444	12.38	-4.985	2.35	.84	.608	4.23	4.68	.00	.00	
2T	22.10	.502	20.02	-6.840	1.62	-.07	.729	8.55	.91	.00	.00	
3T	14.80	.443	12.46	-5.076	2.28	.73	.617	4.28	.78	.00	.00	
4T	14.80	.433	12.49	-4.913	2.35	-.39	.633	4.29	.91	.00	.00	
AVERAGES: 90125 BASELINE W151 00 000												
	21.78	.508	19.85	-7.320	1.52	.11	.736	8.60	5.01	.00	.00	
STD	.15	.003	.23	.710	.20	.31	.010	.10	.70	*	*	
90125 W152TI001 2.5E14												
	15.44	.447	12.98	-5.003	2.38	.46	.617	4.55	1.44	.00	.00	
STD	1.63	.014	1.72	.478	.22	.62	.030	.98	1.4'	*	*	
PERCENT OF BASELINE												
	70.9	88.0	65.4	131.7	156	415.9	83.9	52.8	28.7	*****	*****	
STD%	8.0	3.3	9.5	13.8	37	*****	5.3	12.1	36.3	*****	*****	

TABLE 16 SOLAR CELL I-V DATA (Cont.)

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.562	19.74	-6.286	2.03	-1.05	.739	9.61	.00	.00	.00
1B.*	22.20	.562	19.55	-5.503	2.44	-1.04	.701	9.25	5.46	.00	.00
2B	21.70	.557	19.92	-7.605	1.57	-.02	.751	9.60	5.46	.00	.00
3B	21.30	.553	19.51	-7.524	1.58	.06	.746	9.29	4.55	.00	.00
4B	21.40	.552	19.30	-6.571	1.88	-.30	.726	9.07	4.81	.00	.00
1C	21.30	.538	18.31	-4.918	2.77	-1.20	.669	8.11	2.08	.00	.00
2C	21.20	.537	18.71	-5.713	2.22	-.56	.697	8.39	2.24	.00	.00
3C	21.30	.515	17.53	-4.124	3.51	-1.91	.624	7.24	1.04	.00	.00
4C	21.40	.514	17.61	-4.326	3.25	-.60	.607	7.06	1.04	.00	.00
5C	21.70	.558	19.25	-6.050	2.13	.07	.693	8.88	6.50	.00	.00
6C	21.30	.526	18.58	-5.620	2.22	.34	.664	7.87	1.56	.00	.00
7C	21.20	.517	18.47	-5.956	2.02	1.47	.644	7.47	3.25	.00	.00
8C	21.20	.552	19.04	-6.296	1.99	-.60	.724	8.96	4.68	.00	.00
9C	20.90	.524	17.15	-4.276	3.37	-.81	.607	7.02	2.08	.00	.00
1S	20.90	.537	18.16	-5.234	2.52	-.84	.678	8.04	2.08	.00	.00
2S	21.30	.549	19.25	-6.685	1.83	-.21	.727	8.99	4.03	.00	.00
3S	21.30	.548	18.71	-5.404	2.45	-1.23	.700	8.64	2.99	.00	.00
4S	21.20	.550	19.14	-6.580	1.87	-.40	.729	8.99	4.29	.00	.00
5S	20.70	.544	18.42	-5.966	2.12	-.66	.711	8.46	2.99	.00	.00
6S	20.90	.548	18.81	-6.463	1.91	-.37	.723	8.76	3.90	.00	.00
1T	20.90	.547	18.68	-6.213	2.02	-.29	.711	8.59	3.38	.00	.00
2T	21.9	.524	18.90	-5.059	2.57	-.80	.669	8.12	2.99	.00	.00
3T*	21.00	.540	15.92	-3.346	5.38	-3.04	.548	6.57	1.95	.00	.00
4T	21.20	.547	18.30	-4.914	2.82	-1.66	.681	8.35	2.73	.00	.00
AVERAGES: 90129 BASELINE W079 00 000											
	21.47	.554	19.58	-7.233	1.68	-.08	.741	9.32	4.94	.00	.00
STD	.17	.002	.26	.469	.15	.16	.011	.22	.38	*	*
90129 W153-N/TI-003(1.7E13)											
	21.21	.538	18.50	-5.544	2.42	-.57	.681	8.22	2.99	.00	.00
STD	.28	.014	.58	.786	.51	.73	.039	.64	1.33	*	*
PERCENT OF BASELINE											
	98.8	97.0	94.5	123.4	145	*****	91.9	88.2	60.6	*****	*****
STD%	2.1	2.8	4.2	16.5	46	*****	6.6	9.1	33.7	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90130 W154-N/CR-003 (5E14) W079 00 000

9/18/79 AM1: P0-91.600W/CR02 NO AX CORRECT

TC	ISC	VOC	IP	LOG(IC)	N	R	FF	EFF	OCB	PCDa	PCDb
2A*	21.90	.562	19.86	-6.691	2.87	-.64	.741	9.65	.00	.00	.00
> 079 N BASE											
2B*	22.20	.550	18.98	-4.777	2.94	-1.29	.664	8.57	3.38	.00	.00
2E*	21.50	.546	18.98	-5.714	2.25	-.58	.697	8.66	4.29	.00	.00
3E*	22.10	.536	19.00	-5.043	2.64	-.56	.660	8.87	2.54	.00	.00
4E	22.50	.561	19.95	-5.843	2.23	-.51	.703	8.93	4.81	.00	.00
5B	22.40	.550	19.70	-5.540	2.36	-.72	.694	9.05	4.55	.00	.00
> 154 N/CR 003 S											
1	20.10	.537	17.57	-5.330	2.47	-1.16	.691	7.88	1.95	.00	.00
2	20.10	.531	17.20	-4.847	2.82	-1.30	.663	7.49	1.56	.00	.00
3	19.60	.487	15.67	-4.122	3.37	-.08	.570	5.76	.65	.00	.00
4	19.50	.519	16.41	-4.552	3.05	-1.46	.644	6.89	1.43	.00	.00
5	19.60	.513	16.42	-4.537	3.03	-1.12	.634	6.74	1.04	.00	.00
6	19.90	.529	17.06	-4.884	2.78	-1.34	.667	7.42	1.56	.00	.00
>154 N/CR 003 T											
1	18.90	.536	16.90	-6.188	2.01	-.66	.717	7.69	1.82	.00	.00
2	19.50	.519	16.24	-4.431	3.19	-1.31	.629	6.73	1.04	.00	.00
3	18.80	.523	16.36	-5.295	2.45	-.99	.681	7.08	1.56	.00	.00
4	19.10	.497	14.92	-3.470	4.72	-4.27	.588	5.90	.65	.00	.00
5	19.70	.522	16.76	-4.878	2.75	-.63	.646	7.03	1.30	.00	.00
6	19.20	.529	16.98	-5.840	2.14	-.50	.698	7.49	3.90	.00	.00
2A*	21.90	.561	19.58	-5.864	2.23	-1.51	.734	9.53	.00	.00	.00
> 90130 154 N/CR 003-CTR											
1	19.23	.523	16.72	-5.354	2.40	-.76	.679	7.21	1.56	.00	.00
2	19.40	.531	17.00	-5.543	2.32	-.63	.686	7.48	1.95	.00	.00
3	18.40	.530	16.69	-7.071	1.66	.23	.725	7.48	2.86	.00	.00
4	20.10	.529	16.88	-4.407	3.26	-2.09	.650	7.30	1.43	.00	.00
5	18.70	.532	16.71	-6.260	1.96	-.30	.710	7.47	1.95	.00	.00
6	18.90	.529	16.90	-6.299	1.93	-.23	.710	7.50	2.34	.00	.00
7	19.30	.534	17.44	-6.899	1.72	.26	.719	7.84	2.86	.00	.00
8	19.80	.538	17.93	-6.850	1.75	-.12	.729	8.21	2.86	.00	.00
9	18.70	.533	17.02	-7.172	1.64	-.02	.736	7.76	2.86	.00	.00
10	19.10	.527	16.91	-5.846	2.13	-.62	.701	7.46	2.34	.00	.00
11	19.40	.529	16.87	-5.261	2.49	-1.01	.681	7.39	2.08	.00	.00
AVERAGES: 90130 BASELINE W079 00 000											
	22.45	.556	19.83	-5.691	2.30	-.62	.699	9.22	4.68	.00	.00
STD	.05	.005	.12	.151	.06	.10	.004	.17	.13	*	*
90130 W154-N/CR-003 (5E14)											
	19.35	.525	16.76	-5.449	2.52	-.87	.676	7.27	1.89	.00	.00
STD	.47	.012	.60	.988	.70	.93	.043	.56	.78	*	*
PERCENT OF BASELINE											
	86.2	94.5	84.5	104.3	110	58.0	96.8	78.9	40.5	*****	*****
STD	2.3	3.1	3.6	20.4	34	199.5	6.7	7.7	18.3	*****	*****



TABLE 16 SOLAR CELL I-V DATA (Cont.)

90206 W155-N/MO-001 (1E12) W079 00 000

SE3 4 /18/79 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.562	19.72	-6.221	2.06	-1.18	.740	9.63	.00	.00	.00
>90206 079 BASE											
1S	21.90	.567	19.99	-7.175	1.72	-.24	.745	9.78	4.29	.00	.00
2A*	21.70	.550	18.68	-4.889	2.65	-1.43	.674	8.51	2.86	.00	.00
3F	21.70	.558	19.29	-5.877	2.21	-.72	.710	9.09	3.64	.00	.00
4B*	21.70	.548	18.13	-4.299	3.47	-2.04	.644	8.09	1.69	.00	.00
5S*	21.60	.534	18.48	-4.915	2.74	-.72	.656	8.00	1.82	.00	.00
>90206											
2	21.10	.548	18.76	-5.850	2.19	-.91	.714	8.73	2.73	.00	.00
3	21.30	.537	18.85	-5.855	2.14	-.32	.696	8.42	2.34	.00	.00
4	21.40	.541	18.58	-5.858	2.16	1.55	.639	7.83	2.21	.00	.00
5	21.00	.550	18.88	-6.338	1.97	-.64	.727	8.88	3.38	.00	.00
>90206											
1	20.90	.544	18.50	-5.760	2.23	-.73	.703	8.46	2.86	.00	.00
2	20.90	.520	17.47	-4.467	3.12	-1.12	.632	7.26	1.04	.00	.00
3	21.00	.535	18.10	-4.983	2.70	-1.18	.672	7.98	1.82	.00	.00
4	21.10	.539	18.38	-5.223	2.54	-1.16	.687	8.26	1.95	.00	.00
5	21.20	.540	18.74	-5.829	2.17	-.32	.695	8.41	2.86	.00	.00
2R*	21.90	.562	19.75	-6.278	2.03	-1.20	.743	9.67	.00	.00	.00
>90206											
1	21.30	.534	18.42	-5.051	2.64	-1.17	.677	8.15	1.56	.00	.00
2	21.10	.535	17.93	-4.804	2.86	-.70	.646	7.72	1.95	.00	.00
4*	21.00	.543	15.46	-3.568	4.78	.96	.491	5.92	1.95	.00	.00
6*	21.20	.526	14.56	-2.633	8.75	-8.14	.497	5.86	1.04	.00	.00
7	21.40	.539	18.69	-5.611	2.28	.15	.670	8.17	2.21	.00	.00
8	21.60	.539	18.93	-5.478	2.36	-.63	.687	8.46	2.08	.00	.00
9	21.50	.543	19.31	-6.439	1.90	-.12	.715	8.83	3.38	.00	.00
AVERAGES: 90206 BASELINE W079 00 000											
	21.80	.563	19.64	-6.526	1.96	-.48	.727	9.44	3.97	.00	.00
STD	.10	.005	.35	.649	.25	.24	.018	.35	.32	*	*
90206 W155-N/MO-001 (1E12)											
	21.20	.539	18.54	-5.539	2.38	-.52	.683	8.25	2.31	.00	.00
STD	.21	.007	.45	.549	.34	.70	.028	.43	.64	*	*
PERCENT OF BASELINE											
	97.2	95.8	94.4	115.1	121	91.1	93.9	87.5	58.3	*****	*****
STDZ	1.4	2.0	4.0	17.7	34	274.8	6.2	8.0	22.4	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90202 W156-N/MO-002 (4E12) W079 00 000

\*SH2 1 /28/80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.560	19.70	-6.119	2.10	-1.36	.741	9.62	.00	.00	.00
>90202 079 N-BASE											
1B.*	22.40	.544	18.89	-4.526	3.16	-1.33	.646	8.33	2.86	.00	.00
2B.*	22.40	.528	18.17	-4.134	3.55	-.60	.592	7.40	1.17	.00	.00
3B.*	21.70	.685	17.97	-10.938	1.23	13.18	.474	7.44	1.82	.00	.00
4B	22.10	.563	19.95	-6.580	1.91	-.34	.728	9.58	6.50	.00	.00
>90202 156 N/MO 002 S											
1.*	19.90	.540	16.30	-5.078	2.67	3.26	.558	6.35	1.56	.00	.00
2	19.80	.497	15.88	-4.087	3.48	-.51	.579	6.02	1.04	.00	.00
3	20.40	.533	17.49	-4.845	2.82	-1.46	.669	7.69	1.43	.00	.00
4	20.00	.526	17.27	-5.121	2.57	-.83	.669	7.44	1.56	.00	.00
5	20.30	.530	17.55	-5.127	2.58	-.91	.672	7.65	1.82	.00	.00
6	20.70	.533	17.66	-4.801	2.86	-1.14	.657	7.67	1.69	.00	.00
>90202 156 N/MO 002 T											
1	19.60	.531	17.00	-5.215	2.53	-.96	.677	7.45	1.56	.00	.00
2	19.90	.530	16.93	-4.889	2.78	-.57	.646	7.20	1.56	.00	.00
3	20.20	.543	17.58	-5.293	2.52	-.85	.680	7.88	2.08	.00	.00
2R*	21.90	.561	19.81	-6.504	1.93	-.87	.742	9.64	.00	.00	.00
>90202 156 N/MO 002 CTR											
1	20.40	.529	17.40	-4.959	2.70	-.38	.646	7.38	1.30	.00	.00
2	20.10	.535	17.28	-4.870	2.82	-1.67	.675	7.68	1.69	.00	.00
3	20.20	.533	17.70	-5.475	2.36	-.78	.689	7.84	2.08	.00	.00
4	20.40	.526	17.38	-4.823	2.80	-.97	.654	7.42	1.56	.00	.00
5	20.20	.535	18.01	-6.251	1.96	.05	.701	8.01	2.34	.00	.00
6	20.00	.488	16.61	-4.539	2.87	-.29	.613	6.33	1.04	.00	.00
7	19.90	.516	16.19	-4.080	3.62	-1.61	.605	6.58	1.04	.00	.00
8	20.20	.511	17.11	-4.737	2.81	-.85	.644	7.03	1.69	.00	.00
9	20.80	.519	17.06	-4.105	3.58	-1.88	.619	7.06	1.04	.00	.00
10	20.50	.517	17.57	-4.986	2.62	-.67	.657	7.36	1.69	.00	.00
11	20.30	.517	16.54	-4.086	3.61	-1.63	.608	6.75	1.04	.00	.00
AVERAGES: 90202 BASELINE W079 00 000											
	22.10	.563	19.95	-6.580	1.91	-.34	.728	9.58	6.50	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
90202 W156-N/MO-002 (4E12)											
	20.21	.524	17.17	-4.657	2.83	-.94	.650	7.29	1.54	.00	.00
STD	.29	.013	.53	.528	.43	.50	.032	.53	.38	*	*
PERCENT OF BASELINE											
	91.4	93.0	86.1	126.2	148	-79.0	89.4	76.1	23.7	*****	*****
STDZ	1.3	2.4	2.7	8.0	23	149.2	4.3	5.5	5.8	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90201 W157-N/TI/V-001 (TI-1E14,V-1E14) W079 00 000  
 5B 4 /19/79 AM1: PO-91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	P	FF	Eff	OCD	PCDa	PCDb
2A*	21.90	.561	19.78	-6.384	1.98	-1.03	.742	9.64	.00	.00	.00
>90201 079 N-BASE											
1B	22.40	.562	20.39	-7.238	1.68	.32	.729	9.71	6.50	.00	.00
2B	22.90	.553	20.18	-5.703	2.27	-.30	.690	9.24	4.55	.00	.00
3B	22.80	.559	20.00	-5.528	2.40	-.43	.685	9.24	4.55	.00	.00
4B*	22.60	.557	19.37	-4.887	2.87	-.90	.661	8.79	3.25	.00	.00
5B	22.60	.554	20.05	-6.104	2.08	.31	.689	9.12	5.20	.00	.00
>90201 157 N/TI/V 001 SEED											
1	18.90	.515	16.32	-5.033	2.60	-1.44	.677	6.97	1.04	.00	.00
2	18.90	.521	15.76	-5.872	2.10	-.72	.705	7.34	1.95	.00	.00
3	18.90	.513	16.44	-5.390	2.34	-.51	.674	6.51	.91	.00	.00
4	19.00	.515	16.27	-4.942	2.67	-1.02	.660	6.53	1.30	.00	.00
5	18.70	.516	16.55	-5.957	2.04	-.18	.694	7.08	1.56	.00	.00
6	19.30	.510	16.50	-4.961	2.62	-.73	.654	6.61	.91	.00	.00
>90201 157 N/TI/V 001 TANG											
1	18.60	.521	16.08	-5.051	2.62	-1.53	.679	6.96	1.17	.00	.00
2	18.70	.520	16.25	-5.243	2.47	-1.13	.681	7.01	1.69	.00	.00
3	18.70	.523	16.73	-6.315	1.90	-.25	.711	7.36	1.95	.00	.00
4	18.50	.524	16.48	-6.110	2.00	-.47	.708	7.26	2.60	.00	.00
5	18.70	.523	16.81	-6.564	1.81	-.03	.715	7.39	2.08	.00	.00
6	18.80	.525	16.80	-6.164	1.98	-.61	.715	7.47	1.69	.00	.00
7	18.50	.504	15.19	-4.185	3.43	-1.91	.618	6.10	.78	.00	.00
2R*	21.90	.565	19.79	-6.417	1.98	-1.03	.743	9.73	.00	.00	.00
>90201 157 N/TI/V 001 CENTER											
1	19.00	.529	15.85	-3.987	3.90	-5.11	.675	7.17	1.95	.00	.00
2	18.30	.528	16.76	-7.625	1.50	.23	.742	7.58	4.55	.00	.00
3	18.60	.517	16.53	-6.083	1.98	-.27	.702	7.14	2.34	.00	.00
4	18.80	.525	16.91	-6.555	1.82	-.15	.718	7.49	3.25	.00	.00
5	18.70	.523	16.88	-6.779	1.73	.01	.722	7.46	3.38	.00	.00
6	17.90	.520	16.17	-6.933	1.67	.35	.717	7.06	3.25	.00	.00
7	18.60	.522	16.52	-6.040	2.02	-.36	.702	7.21	2.86	.00	.00
8	18.50	.513	16.57	-6.356	1.89	-.26	.713	7.29	3.90	.00	.00
9	18.70	.512	16.82	-6.548	1.81	-.16	.718	7.41	2.86	.00	.00
10	18.70	.507	16.15	-5.163	2.47	-.81	.668	6.70	1.82	.00	.00
AVERAGES: 90201 BASELINE W079 00 000											
	22.68	.557	20.15	-6.143	2.11	-.03	.698	9.33	5.20	.00	.00
STD	.19	.004	.15	.665	.27	.35	.018	.22	.80	*	*
90201 W157-N/TI/V-001 (TI-1E14,V-1E14)											
	18.70	.519	16.45	-5.820	2.23	-.74	.694	7.13	2.16	.00	.00
STD	.27	.006	.39	.875	.56	1.08	.027	.32	1.00	*	*
PERCENT OF BASELINE											
	82.5	93.2	81.6	105.3	106	*****	99.4	76.5	41.6	*****	*****
STDZ	1.9	1.7	2.6	26.1	43	*****	6.6	5.4	28.5	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90214 W158N-TI-V-CR001 (5E13-5E13-5.5E14) W079 00 000  
 \*SOL11 1 / 9 / 80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.564	19.46	-5.596	2.39	-1.79	.728	9.51	.00	.00	.00
1B.*	21.50	.560	19.24	-6.087	2.12	-.88	.724	9.22	4.52	.00	.00
2B	21.60	.561	19.52	-6.582	1.91	-.50	.733	9.39	5.05	.00	.00
3B*	21.70	.552	18.82	-5.005	2.76	-1.64	.688	8.72	4.40	.00	.00
4B	21.50	.561	19.72	-7.479	1.61	-.23	.754	9.62	6.38	.00	.00
5B*	22.30	.550	19.23	-4.911	2.82	-1.42	.677	8.79	6.38	.00	.00
1C	19.20	.525	16.73	-5.134	2.57	-1.89	.697	7.43	.91	.00	.00
2C	18.60	.536	16.88	-6.870	1.74	-.53	.740	7.80	1.30	.00	.00
3C	19.00	.534	17.22	-6.786	1.76	-.49	.737	7.90	1.17	.00	.00
4C	18.70	.530	16.62	-5.822	2.16	-1.32	.718	7.53	1.04	.00	.00
5C	19.00	.524	16.26	-4.699	2.94	-2.39	.678	7.13	.78	.00	.00
6C	19.30	.531	17.07	-5.616	2.27	-1.41	.712	7.72	1.17	.00	.00
7C	19.40	.529	17.26	-5.879	2.12	-1.11	.717	7.79	1.17	.00	.00
8C	19.20	.529	17.25	-6.317	1.92	-.75	.726	7.80	1.43	.00	.00
9C	18.50	.530	16.34	-5.705	2.23	-1.03	.704	7.30	1.04	.00	.00
10C	19.00	.537	17.39	-7.435	1.57	-.11	.734	8.06	1.56	.00	.00
1S	19.10	.532	17.30	-6.781	1.76	-.40	.734	7.89	1.56	.00	.00
2S	19.20	.534	17.65	-7.738	1.48	-.03	.753	8.17	1.82	.00	.00
3S	19.10	.531	17.40	-7.095	1.65	-.34	.743	7.97	1.82	.00	.00
4S	19.20	.512	16.01	-4.391	3.20	-1.71	.635	6.61	.65	.00	.00
5S	19.10	.523	16.84	-5.660	2.22	-.90	.700	7.39	1.04	.00	.00
1T	18.70	.527	16.98	-6.999	1.67	-.18	.735	7.66	1.69	.00	.00
2T	19.00	.527	17.07	-6.391	1.88	-.55	.723	7.66	1.43	.00	.00
3T	18.80	.527	16.96	-7.024	1.66	.86	.705	7.39	1.43	.00	.00
4T	18.90	.517	16.13	-4.719	2.88	-1.95	.668	6.90	.91	.00	.00
5T	18.50	.520	16.23	-5.467	2.33	-1.17	.695	7.07	1.17	.00	.00
6T	18.70	.525	17.01	-7.167	1.61	.03	.734	7.62	1.30	.00	.00
AVERAGES: 90214 BASELINE W079 00 000											
	21.55	.561	19.62	-7.030	1.76	-.37	.743	9.50	5.72	.00	.00
STD	.05	.000	.10	.448	.15	.13	.011	.11	.67	*	*
90214 W158N-TI-V-CR001 (5E13-5E13-5.5E14)											
	18.96	.528	16.89	-6.176	2.08	-.83	.714	7.56	1.26	.00	.00
STD	.26	.006	.45	.942	.48	.77	.028	.39	.32	*	*
PERCENT OF BASELINE											
	88.0	94.0	86.1	112.2	118	-26.4	96.1	79.6	22.0	*****	*****
STDZ	1.4	1.1	2.8	19.9	39	369.2	5.2	5.1	8.7	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90216 W159N-CR-MN-TI-V001 (3.5E14-3.2E14-2E13-2E13) W079 00 000  
 \*SOL11 1 / 9 / 80 AML: PO=9i.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.565	19.88	-6.689	1.88	-.81	.747	9.77	.00	.00	.00
1B*	21.40	.562	18.04	-5.718	2.32	3.53	.580	7.38	4.55	.00	.00
2B.*	21.90	.554	19.41	-5.812	2.23	-.58	.703	9.02	3.40	.00	.00
3B	21.90	.557	19.78	-6.637	1.87	-.24	.727	9.38	4.81	.00	.00
4B.*	21.70	.547	19.19	-5.784	2.22	-.49	.699	8.77	3.00	.00	.00
5B*	21.50	.547	18.57	-4.937	2.79	-1.57	.681	8.47	3.38	.00	.00
1C	19.50	.531	17.24	-5.727	2.21	-.88	.703	7.70	.91	.00	.00
2C	19.50	.531	17.71	-6.861	1.72	-.53	.741	8.12	1.56	.00	.00
3C	19.30	.531	17.42	-6.720	1.77	-.12	.724	7.84	1.17	.00	.00
4C	19.60	.526	17.21	-5.539	2.29	-.85	.693	7.56	1.04	.00	.00
5C	19.20	.526	16.67	-5.177	2.54	-1.30	.683	7.29	.91	.00	.00
6C	19.50	.527	17.31	-5.953	2.07	-.52	.704	7.65	1.04	.00	.00
7C	19.50	.531	17.71	-7.037	1.66	.00	.731	8.01	1.43	.00	.00
8C	19.20	.523	17.58	-7.479	1.52	-.07	.747	7.93	1.17	.00	.00
9C	20.00	.528	17.78	-5.971	2.06	-.59	.708	7.91	1.17	.00	.00
10C	19.40	.529	17.56	-6.759	1.75	-.37	.733	7.95	1.56	.00	.00
11C	19.40	.521	16.75	-5.002	2.65	-1.49	.678	7.25	.91	.00	.00
1S	19.30	.530	17.41	-6.575	1.82	-.49	.729	7.89	1.69	.00	.00
2S	19.80	.487	15.75	-3.939	3.63	-.98	.576	5.87	.39	.00	.00
3S	19.40	.512	16.18	-4.385	3.20	-1.70	.636	6.68	.52	.00	.00
4S	19.50	.516	16.47	-4.523	3.06	-1.96	.655	6.97	.78	.00	.00
5S	18.70	.466	13.74	-3.822	3.71	2.55	.478	4.40	.31	.00	.00
6S	19.50	.521	17.20	-5.753	2.15	-.53	.695	7.47	1.30	.00	.00
1T	18.90	.469	14.63	-3.888	3.61	.24	.537	5.04	.30	.00	.00
2T.*	19.00	.507	14.75	-3.436	4.91	-4.33	.581	5.92	.39	.00	.00
3T	19.10	.478	14.94	-3.880	3.69	-.44	.554	5.35	.37	.00	.00
4T	19.20	.528	17.15	-6.186	1.97	-.50	.714	7.65	1.04	.00	.00
5T	18.80	.450	13.97	-3.697	3.80	1.07	.496	4.44	.26	.00	.00
AVERAGES: 90216 BASELINE W079 00 000											
	21.90	.557	19.78	-6.637	1.87	-.24	.727	9.38	4.81	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
90216 W159N-CR-MN-TI-V001 (3.5E14-3.2E14-2E13-2E13)											
	19.35	.512	16.59	-5.470	2.52	-.45	.663	7.00	.94	.00	.00
STD	.30	.025	1.23	1.188	.8	.94	.082	1.19	.44	*	*
PERCENT OF BASELINE											
	88.3	92.0	83.9	117.6	135	12.9	91.2	74.6	19.6	*****	*****
STDZ	1.4	4.5	6.2	17.9	42	392.0	11.2	12.7	9.1	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90219 W160TI001 (1.7E14) W117 00 000  
 \*SOL11 1 / 9 / 80 AML: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.564	20.04	-7.297	1.67	-.31	.751	9.81	.00	.00	.00
2B*	21.00	.552	15.26	-3.109	6.37	-3.36	.511	6.27	3.00	.00	.00
3B.*	21.70	.547	19.06	-5.682	2.27	-.13	.682	8.56	2.34	.00	.00
4B	21.60	.545	19.52	-7.165	1.66	1.05	.703	8.75	3.25	.00	.00
5B	21.90	.546	19.90	-7.406	1.59	.91	.714	9.03	3.51	.00	.00
1C	11.90	.484	10.42	-5.845	2.06	-.24	.678	4.13	.78	.00	.00
2C	11.90	.491	10.84	-7.551	1.46	.65	.728	4.50	1.04	.00	.00
3C	12.00	.491	10.97	-7.850	1.38	.96	.730	4.55	1.04	.00	.00
4C	12.00	.491	11.03	-8.242	1.30	.96	.741	4.61	1.17	.00	.00
5C	11.80	.489	10.82	-8.105	1.32	1.04	.736	4.49	1.04	.00	.00
6C	12.00	.489	10.78	-6.850	1.66	.48	.708	4.39	.91	.00	.00
7C	11.70	.488	10.60	-7.298	1.52	.58	.721	4.35	.91	.00	.00
8C	11.80	.489	10.71	-7.556	1.45	1.30	.708	4.36	.91	.00	.00
9C	11.60	.487	10.57	-7.677	1.42	1.00	.724	4.33	1.04	.00	.00
10C	11.90	.487	10.88	-7.904	1.36	1.11	.728	4.46	1.04	.00	.00
1S	11.60	.484	10.49	-7.421	1.47	1.51	.707	4.20	1.04	.00	.00
2S	11.70	.484	10.52	-7.052	1.58	1.08	.703	4.21	.91	.00	.00
3S	11.90	.482	10.68	-7.028	1.58	1.37	.696	4.22	.91	.00	.00
4S	11.80	.481	10.54	-6.809	1.65	1.35	.689	4.14	.78	.00	.00
5S	11.90	.474	10.47	-6.102	1.90	.46	.677	4.04	.78	.00	.00
6S	11.70	.479	10.55	-7.208	1.52	1.30	.704	4.17	.91	.00	.00
1T	11.80	.492	10.75	-7.580	1.45	.59	.730	4.48	.78	.00	.00
2T	11.80	.492	10.83	-8.143	1.32	1.04	.737	4.52	.91	.00	.00
3T	11.30	.475	9.47	-4.762	2.82	-2.05	.637	3.62	.78	.00	.00
4T	11.70	.482	10.29	-5.974	1.99	-.19	.683	4.07	1.04	.00	.00
5T	11.40	.486	10.41	-8.103	1.32	1.91	.718	4.21	1.04	.00	.00
6T	11.90	.487	10.91	-8.090	1.32	1.11	.734	4.50	1.04	.00	.00
AVERAGES: 90219 BASELINE W117 00 000											
	21.75	.546	19.71	-7.285	1.62	.98	.709	8.89	3.38	.00	.00
STD	.15	.000	.19	.121	.03	.07	.006	.14	.13	*	*
90219 W160TI001 (1.7E14)											
	11.78	.486	10.61	-7.234	1.58	.79	.710	4.30	.95	.00	.00
STD	.18	.005	.32	.874	.34	.79	.025	.22	.11	*	*
PERCENT OF BASELINE											
	54.1	89.0	53.9	100.7	98	80.6	100.2	48.3	28.0	*****	*****
STD%	1.2	1.0	2.1	13.8	24	92.9	4.4	3.3	4.5	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90403 W\*\*161TI002 21-31 OHM-CM (3E13) W117 00 000

\*SOL12 1 /10/80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.560	19.79	-6.461	1.95	-.84	.739	9.59	.00	.00	.00
1B*	22.00	.548	19.16	-5.225	2.57	-1.00	.684	8.72	2.60	.00	.00
2B	22.40	.553	20.66	-8.106	1.43	.40	.750	9.83	5.20	.00	.00
3B	22.20	.552	20.12	-6.812	1.79	-.17	.731	9.48	4.42	.00	.00
4B*	22.10	.548	19.40	-5.562	2.34	-.47	.687	8.80	3.25	.00	.00
1151	23.30	.493	21.18	-7.610	1.38	1.15	.706	8.57	8.30	.00	.00
1512	23.30	.488	20.25	-5.721	1.99	.93	.648	7.79	10.40	.00	.00
1C	18.80	.480	15.92	-4.978	2.47	.15	.630	6.02	.52	.00	.00
2C	18.40	.478	15.64	-5.028	2.42	.04	.636	5.92	.39	.00	.00
3C	18.60	.476	15.59	-4.660	2.71	-.59	.628	5.88	.50	.00	.00
4C	18.80	.477	15.77	-4.623	2.75	-.81	.632	5.99	.39	.00	.00
5C	18.80	.476	15.89	-4.729	2.65	-.91	.643	6.08	.52	.00	.00
6C	18.70	.477	15.73	-4.779	2.61	-.22	.627	5.92	.52	.00	.00
7C	17.90	.479	15.24	-5.222	2.30	.71	.629	5.71	.39	.00	.00
8C	18.50	.480	15.68	-5.088	2.39	.58	.625	5.87	.52	.00	.00
9C	19.10	.480	16.18	-4.886	2.53	-.25	.636	6.17	.52	.00	.00
10C	18.50	.477	15.70	-4.866	2.54	-.59	.643	6.00	.52	.00	.00
1S	18.70	.477	15.54	-4.734	2.65	.51	.604	5.69	.39	.00	.00
2S	18.50	.477	15.51	-4.879	2.53	.51	.614	5.73	.39	.00	.00
3S	18.40	.476	15.40	-4.858	2.55	.50	.612	5.67	.46	.00	.00
4S	18.10	.474	15.37	-5.334	2.20	1.38	.617	5.60	.39	.00	.00
5S	18.70	.476	15.67	-4.843	2.55	.40	.614	5.78	.39	.00	.00
6S	14.80	.468	11.96	-4.447	2.99	.52	.576	4.22	.39	.00	.00
1T	17.80	.475	15.13	-5.313	2.23	1.21	.621	5.55	.39	.00	.00
2T	18.30	.474	16.26	-7.041	1.49	2.47	.654	6.00	.52	.00	.00
3T	18.50	.474	15.58	-4.957	2.46	.51	.619	5.74	.39	.00	.00
4T	18.50	.472	15.57	-5.007	2.41	.79	.614	5.67	.39	.00	.00
5T	18.60	.472	15.53	-4.912	2.48	.95	.603	5.60	.39	.00	.00
6T	18.60	.472	15.72	-5.219	2.26	1.34	.611	5.68	.39	.00	.00
AVERAGES: 90403 BASELINE W117 00 000											
	22.30	.553	20.39	-7.459	1.61	.11	.741	9.65	4.81	.00	.00
STD	.10	.001	.27	.647	.18	.28	.009	.17	.39	*	*
90403 W**161TI002 21-31 OHM-CM (3E13)											
	18.76	.477	15.92	-5.155	2.40	.47	.627	5.95	1.18	.00	.00
STD	1.58	.005	1.65	.710	.35	.77	.023	.77	2.48	*	*
PERCENT OF BASELINE											
	84.1	86.3	78.1	130.9	149	418.7	84.6	61.7	24.6	*****	*****
STD%	7.5	1.0	9.2	16.3	41	*****	4.3	9.2	57.8	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90402 W162NI-TI001 (4E15-1.6E14) W117 00 000

\*SOL11 1 /9 /80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.561	20.00	-7.189	1.69	-.29	.747	9.71	.00	.00	.00
1B	22.20	.552	20.02	-6.694	1.83	.10	.718	9.31	3.90	.00	.00
2B	22.50	.555	20.80	-8.271	1.40	.40	.754	9.96	6.24	.00	.00
3B	22.50	.555	20.69	-7.761	1.52	.12	.71	9.92	5.20	.00	.00
4B	22.40	.549	20.02	-6.188	2.02	-.27	.711	9.24	4.16	.00	.00
5B	22.30	.549	20.19	-6.846	1.77	.04	.726	9.40	3.64	.00	.00
1C.*	10.30	.471	9.74	-14.947	.61	7.70	.703	3.61	1.04	.00	.00
2C	12.60	.467	11.01	-6.126	1.85	1.66	.654	4.07	.91	.00	.00
3C	12.40	.464	10.95	-6.335	1.75	.98	.677	4.12	.91	.00	.00
4C	12.80	.467	11.46	-6.935	1.55	1.43	.690	4.36	.78	.00	.00
5C	12.70	.466	11.27	-6.491	1.69	.97	.683	4.28	.78	.00	.00
6C	12.50	.464	11.12	-6.544	1.67	.77	.690	4.23	.91	.00	.00
7C	12.80	.466	11.37	-6.441	1.71	.64	.688	4.34	.91	.00	.00
8C	12.60	.459	10.92	-5.645	2.05	.26	.659	4.03	.91	.00	.00
9C	12.70	.462	11.23	-6.239	1.78	.45	.684	4.24	.91	.00	.00
10C	12.80	.462	11.40	-6.589	1.64	.91	.688	4.31	.91	.00	.00
11C	12.80	.462	11.40	-6.589	1.64	.91	.688	4.31	.91	.00	.00
1S	13.10	.465	11.55	-6.067	1.86	.04	.685	4.42	.78	.00	.00
2S	13.10	.433	10.48	-4.305	2.98	-.08	.571	3.42	.30	.00	.00
3S	13.00	.462	11.37	-5.726	2.01	-.46	.679	4.31	.72	.00	.00
4S	13.00	.462	11.45	-5.894	1.93	-.64	.692	4.39	.91	.00	.00
5S	13.00	.463	11.41	-5.773	1.99	-.69	.686	4.37	.91	.00	.00
6S	13.10	.460	11.55	-6.127	1.81	.32	.682	4.35	.91	.00	.00
1T	12.30	.466	10.89	-6.292	1.78	.46	.686	4.16	.91	.00	.00
2T	12.50	.463	11.02	-6.193	1.80	.66	.677	4.15	.91	.00	.00
3T	12.50	.465	11.00	-6.043	1.88	.15	.681	4.19	.91	.00	.00
4T	12.50	.465	11.10	-6.385	1.73	.45	.690	4.24	.91	.00	.00
5T	12.70	.463	11.17	-6.022	1.87	.15	.680	4.23	.78	.00	.00
6T	12.60	.462	11.08	-6.052	1.86	.27	.679	4.18	1.69	.00	.00

AVERAGES: 90402 BASELINE W117 00 000

	22.38	.552	20.34	-7.152	1.71	.08	.732	9.56	4.63	.00	.00
STD	.12	.003	.33	.756	.22	.21	.017	.31	.96	*	*
	90402 W162NI-TI001 (4E15-1.6E14)										
	12.73	.462	11.19	-6.128	1.86	.44	.677	4.21	.89	.00	.00
STD	.23	.007	.26	.503	.28	.59	.025	.20	.22	*	*
PERCENT OF BASELINE											
	56.9	83.7	55.0	114.3	109	557.9	92.5	44.1	19.1	*****	*****
STD%	1.3	1.6	2.2	16.8	32	*****	5.7	3.6	9.7	*****	*****



TABLE 16 SOLAR CELL I-V DATA (Cont.)

90405 W163NI/V001 (4E15-4.4E14) W117 00 000  
 \*SOL12 1 /10/80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.553	19.87	-6.754	1.81	-.51	.740	9.48	.00	.00	.00
1B	21.50	.544	19.56	-6.970	1.71	-.33	.741	9.17	4.29	.00	.00
2B.*	22.20	.546	19.65	-5.662	2.28	-.99	.709	9.09	3.90	.00	.00
3B	21.90	.545	19.86	-6.794	1.77	-.34	.736	9.29	4.16	.00	.00
4B.*	22.00	.544	19.57	-5.766	2.21	-1.15	.719	9.10	3.90	.00	.00
5B	21.90	.547	20.11	-7.526	1.56	-.20	.755	9.56	4.94	.00	.00
1C	14.90	.475	13.27	-6.470	1.71	.58	.692	5.18	.65	.00	.00
3C	14.90	.480	13.44	-6.932	1.57	.30	.716	5.42	.91	.00	.00
4C	14.90	.479	13.41	-6.819	1.60	.32	.712	5.37	1.04	.00	.00
5C	15.20	.478	13.56	-6.424	1.73	.14	.701	5.39	.91	.00	.00
6C	15.10	.476	13.36	-6.044	1.88	-.20	.693	5.27	1.00	.00	.00
7C	15.20	.478	13.56	-6.424	1.73	.14	.701	5.39	.91	.00	.00
8C	14.80	.476	13.23	-6.546	1.69	.28	.702	5.23	.65	.00	.00
9C	15.00	.476	13.29	-6.090	1.86	-.20	.695	5.25	.65	.00	.00
10C	15.10	.477	13.51	-6.473	1.71	-.07	.708	5.40	.78	.00	.00
11C	14.80	.473	13.12	-6.160	1.82	.00	.693	5.13	.72	.00	.00
1S	15.40	.478	14.04	-7.532	1.40	.58	.728	5.67	.78	.00	.00
2S	15.20	.478	13.68	-6.825	1.59	.30	.713	5.48	.78	.00	.00
3S	15.40	.480	13.80	-6.502	1.71	-.13	.711	5.56	.91	.00	.00
4S	15.10	.478	13.41	-6.203	1.82	-.04	.696	5.31	.83	.00	.00
5S	15.50	.477	13.71	-6.061	1.87	-.07	.691	5.40	.65	.00	.00
6S	15.40	.478	13.92	-6.933	1.56	.05	.723	5.63	.78	.00	.00
1T	14.70	.478	13.20	-6.731	1.63	.28	.709	5.27	.65	.00	.00
2T	14.80	.475	13.09	-6.056	1.88	-.14	.692	5.14	.78	.00	.00
3T	15.20	.478	13.55	-6.294	1.78	-.20	.705	5.41	.78	.00	.00
4T	14.80	.474	13.12	-6.170	1.82	.00	.693	5.14	.91	.00	.00
5T	15.00	.476	13.58	-7.073	1.51	.20	.723	5.46	.65	.00	.00
6T	15.00	.476	13.33	-6.284	1.78	.12	.696	5.25	.78	.00	.00

AVERAGES: 90405 BASELINE W117 00 000

	21.77	.545	19.84	-7.097	1.68	-.29	.744	9.34	4.46	.00	.00
STD	.19	.001	.22	.312	.09	.06	.008	.16	.34	*	*

90405 W163NI/V001 (4E15-4.4E14)

	15.06	.477	13.46	-6.502	1.71	.10	.704	5.35	.80	.00	.00
STD	.22	.002	.25	.382	.13	.23	.011	.15	.12	*	*
PERCENT OF BASELINE	69.2	87.5	67.9	108.4	102	235.6	94.7	57.3	17.8	*****	*****
STDZ	1.6	.5	2.0	9.6	14	103.8	2.5	2.6	4.2	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90409 W164NI-M0001 (4E15-4E12) W117 00 000

\*SOL12 1 /10/80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.553	19.86	-6.709	1.83	-.61	.742	9.50	.00	.00	.00
1B	21.60	.546	20.05	-8.553	1.32	.22	.767	9.56	4.29	.00	.00
2B	21.80	.544	19.82	-6.961	1.71	-.21	.737	9.25	3.90	.00	.00
3B	21.80	.545	20.24	-8.558	1.32	.27	.765	9.61	4.42	.00	.00
4B	22.00	.547	20.33	-8.238	1.39	.52	.756	9.62	4.55	.00	.00
5B	21.70	.546	20.21	-8.935	1.25	.45	.767	9.61	4.55	.00	.00
1C	18.10	.503	16.09	-5.996	1.98	-.64	.708	6.81	.56	.00	.00
2C	18.30	.502	16.34	-6.195	1.88	-.49	.713	6.93	.91	.00	.00
3C	13.10	.500	16.22	-6.343	1.82	-.42	.717	6.86	.91	.00	.00
4C	18.50	.503	16.66	-6.520	1.75	-.45	.725	7.14	.91	.00	.00
5C	18.70	.503	16.80	-6.501	1.76	-.22	.718	7.14	.65	.00	.00
6C	18.20	.499	16.30	-6.322	1.82	-.39	.715	6.87	.65	.00	.00
7C	18.30	.495	15.98	-5.424	2.24	-.84	.684	6.56	.52	.00	.00
8C	18.30	.500	16.34	-6.244	1.85	-.26	.708	6.85	.65	.00	.00
9C	18.10	.500	16.17	-6.222	1.86	-.46	.713	6.82	.65	.00	.00
10C	18.50	.498	16.29	-5.693	2.10	-.66	.694	6.77	.52	.00	.00
11C	18.20	.498	16.14	-5.925	1.99	-.62	.704	6.75	.65	.00	.00
1S	18.00	.500	16.33	-6.952	1.60	-.21	.733	6.98	.78	.00	.00
2S	18.70	.500	16.54	-5.790	2.06	-.72	.701	6.94	.65	.00	.00
3S	18.70	.500	16.51	-5.742	2.08	-.69	.698	6.90	.65	.00	.00
4S	18.70	.501	16.73	-6.312	1.83	-.28	.712	7.06	.65	.00	.00
5S	18.80	.501	16.72	-5.987	1.96	-.63	.709	7.06	.91	.00	.00
6S	18.70	.501	16.70	-6.251	1.85	-.26	.709	7.02	.91	.00	.00
1T.*	17.20	.493	13.76	-3.591	4.49	-5.87	.626	5.61	3.00	.00	.00
2T	17.80	.492	15.05	-4.615	2.87	-1.87	.654	6.06	.44	.00	.00
3T	18.00	.500	16.04	-6.156	1.89	-.38	.708	6.73	.60	.00	.00
4T	17.60	.496	15.60	-5.906	2.00	-.71	.705	6.50	.65	.00	.00
5T	17.70	.496	15.62	-5.825	2.03	-.49	.695	6.45	.78	.00	.00

AVERAGES: 90409 BASELINE W117 00 000

	21.78	.546	20.13	-8.249	1.40	.21	.758	9.53	4.34	.00	.00
STD	.13	.001	.18	.681	.16	.22	.011	.14	.24	*	*

90409 W164NI-M0001 (4E15-4E12)

	18.29	.499	16.25	-6.044	1.96	-.56	.706	6.82	.70	.00	.00
STD	.35	.003	.42	.450	.25	.34	.016	.25	.14	*	*

PERCENT OF BASELINE

	84.0	91.5	80.7	126.7	140	*****	93.1	71.6	16.0	*****	*****
STD%	2.1	.7	2.8	12.1	36	620.3	3.5	3.7	4.3	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90515 W165C0002 (6E14) W133 00 000

\*SOL12 1 /10/80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDI
2R*	21.90	.559	19.80	-6.511	1.92	-.77	.739	9.57	00	.00	.00
1B	21.90	.551	19.84	-6.697	1.83	-.51	.738	9.42	.64	.00	.00
2B	22.00	.551	19.90	-6.530	1.89	-.74	.739	9.48	3.25	.00	.00
3B	22.10	.549	19.78	-6.069	2.08	-.86	.724	9.29	3.90	.00	.00
1C	22.00	.553	19.80	-6.209	2.03	-1.00	.737	9.48	3.90	.00	.00
2C	21.60	.551	19.79	-7.305	1.63	-.42	.755	9.50	3.90	.00	.00
3C	22.00	.552	19.97	-6.716	1.82	-.68	.744	9.56	3.90	.00	.00
4C	21.70	.546	19.45	-6.056	2.08	-1.12	.731	9.16	3.12	.00	.00
5C	22.00	.553	20.37	-8.176	1.42	-.12	.769	9.90	4.29	.00	.00
6C	21.90	.550	19.97	-6.961	.73	-.61	.751	9.56	3.12	.00	.00
7C	22.00	.551	20.00	-6.824	1.78	-.60	.746	9.56	3.90	.00	.00
8C	22.10	.549	20.25	-7.306	1.62	-.42	.756	9.70	4.42	.00	.00
9C	22.10	.536	18.96	-4.732	2.91	-1.80	.676	8.47	2.08	.00	.00
10C	22.20	.546	20.38	-7.652	1.52	.08	.749	9.60	4.42	.00	.00
11C	22.10	.549	20.25	-7.366	1.61	-.31	.754	9.68	4.29	.00	.00
12C	22.20	.545	19.72	-5.751	2.22	-1.03	.715	9.15	3.00	.00	.00
13C	22.00	.546	19.48	-5.618	2.30	-1.18	.712	9.05	3.38	.00	.00
14C	21.90	.550	19.80	-6.493	1.90	-.79	.739	9.42	3.64	.00	.00
1S	21.80	.545	19.05	-5.095	2.65	-2.00	.706	8.87	2.60	.00	.00
2S	21.90	.544	19.08	-5.047	2.68	-1.88	.700	8.81	2.60	.00	.00
3S	21.90	.544	19.26	-5.331	2.48	-1.62	.710	8.94	3.00	.00	.00
4S	22.30	.548	20.53	-7.722	1.5	-.15	.759	9.81	4.29	.00	.00
5S	22.00	.546	20.22	-7.671	1.52	-.03	.753	9.57	3.90	.00	.00
6S	22.30	.544	20.04	-6.270	1.97	-.66	.727	9.33	3.90	.00	.00
1T	21.90	.548	20.16	-7.887	1.47	.18	.752	9.54	4.29	.00	.00
2T	22.40	.541	20.15	-6.453	1.88	-.26	.721	9.25	3.64	.00	.00
3T	22.20	.547	19.90	-6.104	2.05	-.92	.728	9.35	2.60	.00	.00
4T	22.00	.546	20.10	-7.216	1.64	-.26	.748	9.50	3.90	.00	.00
5T	22.10	.547	19.14	-4.852	2.86	-2.20	.696	8.90	3.00	.00	.00
6T	22.10	.549	19.92	-6.381	1.94	-.74	.734	9.41	3.64	.00	.00

AVERAGES: 90515 BASELINE W133 00 000

	22.00	.550	19.84	-6.430	1.93	-.70	.734	9.39	3.60	.00	.00
STD	.08	.001	.05	.264	.11	.14	.007	.08	.27	*	*

90515 W165C0002 (6E14)

	22.03	.547	19.84	-6.507	1.97	-.79	.733	9.35	3.57	.00	.00
STD	.18	.004	.44	.980	.43	.65	.023	.34	.64	*	*

PERCENT OF BASELINE

	100.1	99.4	100.0	98.8	102	87.2	100.0	99.5	99.2	*****	*****
STD%	1.2	.8	2.5	20.0	29	134.6	4.0	4.4	26.6	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90516 W166FE007 (1.06E15) W133 00 000

\*SOL12 1 /10/80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.555	19.84	-6.620	1.87	-.69	.741	9.52	.00	.00	.00
1B	22.00	.553	20.17	-7.433	1.60	-.19	.752	9.67	4.55	.00	.00
2B	22.30	.556	20.68	-8.340	1.39	-.00	.769	10.09	4.94	.00	.00
3B	22.10	.554	20.30	-7.674	1.54	.10	.749	9.70	4.68	.00	.00
4B	21.90	.555	19.99	-7.109	1.70	-.41	.749	9.62	4.42	.00	.00
5B	22.00	.552	20.12	-7.277	1.64	-.26	.750	9.63	4.29	.00	.00
1C	21.20	.529	18.01	-4.558	3.06	-1.99	.665	7.88	1.04	.00	.00
2C	19.60	.520	17.22	-5.461	2.31	-1.21	.699	7.54	.91	.00	.00
3C	21.40	.539	19.36	-6.714	1.78	-.30	.731	8.92	2.34	.00	.00
4C	21.40	.540	19.18	-6.193	1.99	-.69	.723	8.84	2.08	.00	.00
5C	20.20	.530	18.05	-6.063	2.03	-.82	.720	8.15	1.43	.00	.00
6C	20.50	.531	18.13	-5.639	2.24	-1.16	.710	8.17	1.56	.00	.00
7C.*	18.00	.500	13.76	-3.136	5.93	-8.10	.594	5.65	.33	.00	.00
8C	21.20	.538	19.09	-6.320	1.93	-.87	.734	8.85	2.21	.00	.00
9C	21.30	.525	18.04	-4.519	3.08	-1.90	.650	7.80	1.00	.00	.00
10C	21.40	.532	18.57	-4.994	2.67	-1.73	.691	8.32	1.69	.00	.00
1S	21.40	.532	18.57	-4.994	2.67	-1.73	.691	8.32	1.69	.00	.00
2S	21.50	.537	18.71	-5.051	2.65	-1.78	.696	8.50	1.95	.00	.00
3S	21.20	.524	16.98	-4.397	3.21	1.55	.554	6.51	.91	.00	.00
4S	21.50	.538	19.03	-5.578	2.30	-1.35	.715	8.74	2.21	.00	.00
5S	20.90	.530	18.00	-4.751	2.88	-2.33	.689	8.07	1.30	.00	.00
6S	21.40	.534	18.48	-4.881	2.78	-1.79	.685	8.27	1.56	.00	.00
1T	20.00	.526	17.61	-5.599	2.25	-.83	.697	7.75	1.04	.00	.00
2T.*	19.00	.515	15.25	-3.541	4.71	-5.98	.635	6.57	.50	.00	.00
3T	20.90	.534	18.97	-6.905	1.71	-.20	.734	8.67	1.69	.00	.00
4T	20.00	.525	17.51	-5.184	2.51	-1.48	.692	7.72	1.00	.00	.00
5T	21.10	.535	18.94	-6.287	1.94	-.59	.724	8.64	1.82	.00	.00
6T	20.70	.530	18.44	-5.953	2.07	-.82	.716	8.30	1.56	.00	.00
AVERAGES: 90516 BASELINE W133 00 000											
	22.06	.554	20.25	-7.567	1.57	-.15	.754	9.74	4.58	.00	.00
STD	.14	.001	.24	.429	.11	.18	.008	.18	.22	*	*
90516 W166FE007 (1.06E15)											
	20.95	.531	18.35	-5.502	2.40	-1.10	.696	8.20	.55	.00	.00
STD	.56	.005	.66	.728	.4	.84	.039	.56	.45	*	*
PERCENT OF BASELINE											
	94.9	95.9	90.6	127.3	100	****	92.4	84.2	33.9	*****	*****
STD%	3.1	1.2	4.3	14.3	40	*****	6.1	7.3	12.0	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90517 W167NB001 (1.5E13) W133 00 000

\*SOL12 1 /10/80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.557	19.78	-6.435	1.95	-.84	.738	9.53	.00	.00	.00
1B	21.50	.552	19.29	-6.181	2.04	-.87	.728	9.14	4.16	.00	.00
2B	22.00	.548	20.07	-7.175	1.66	-.12	.742	9.46	3.51	.00	.00
3B	21.90	.552	19.85	-6.863	1.77	-.08	.730	9.33	4.29	.00	.00
4B	22.00	.553	20.13	-7.649	1.54	.59	.732	9.41	4.42	.00	.00
1C	19.00	.513	16.75	-5.650	2.18	-.86	.698	7.20	.52	.00	.00
2C	19.80	.513	17.07	-4.965	2.63	-1.45	.676	7.26	.52	.00	.00
3C	19.10	.513	16.94	-5.912	2.04	-.61	.704	7.30	.60	.00	.00
4C	18.90	.502	16.07	-4.755	2.77	-1.36	.656	6.58	4.00	.00	.00
5C	18.60	.515	16.49	-5.852	2.09	-.83	.707	7.16	.65	.00	.00
6C	18.70	.512	16.53	-5.791	2.11	-.66	.699	7.08	.65	.00	.00
7C	18.60	.515	16.67	-6.339	1.87	-.42	.717	7.26	.65	.00	.00
8C	19.10	.521	17.16	-6.445	1.84	-.34	.720	7.57	.65	.00	.00
9C	18.70	.513	16.65	-6.070	1.97	-.53	.709	7.19	.65	.00	.00
10C	18.60	.510	16.62	-6.200	1.91	-.50	.714	7.16	.65	.00	.00
1S	18.70	.519	16.86	-6.653	1.76	-.22	.724	7.43	.65	.00	.00
2S	19.40	.517	16.92	-5.626	2.21	.24	.666	7.07	.52	.00	.00
3S	18.90	.509	16.17	-4.944	2.64	-.92	.657	6.69	.52	.00	.00
4S	19.00	.515	16.37	-6.054	1.99	-.19	.699	7.23	.65	.00	.00
5S	18.90	.513	16.54	-5.613	2.20	-.21	.678	6.95	.65	.00	.00
1T	18.50	.509	16.37	-5.917	2.03	-.34	.696	6.93	.52	.00	.00
2T	18.10	.508	16.22	-6.601	1.75	.40	.703	6.84	.65	.00	.00
3T	18.30	.502	15.80	-5.203	2.42	-.67	.666	6.47	.52	.00	.00
4T	18.30	.502	15.93	-5.399	2.29	-.62	.676	6.57	.52	.00	.00
5T	18.20	.501	15.72	-5.168	2.44	-.86	.669	6.45	.52	.00	.00
6T	18.20	.507	16.22	-6.268	1.87	-.01	.702	6.85	.60	.00	.00
AVERAGES: 90517 BASELINE W133 00 000											
	21.85	.551	19.83	-6.967	1.75	-.12	.733	9.33	4.10	.00	.00
STD	.21	.002	.33	.533	.19	.52	.005	.12	.35	*	*
90517 W167NB001 (1.5E13)											
	18.74	.511	16.50	-5.782	2.14	-.52	.692	7.01	.76	.00	.00
STD	.41	.006	.40	.541	.29	.45	.021	.31	.73	*	*
PERCENT OF BASELINE											
	85.8	92.7	83.2	117.0	122	*****	94.5	75.1	18.4	*****	*****
STD%	2.7	1.3	3.4	14.7	31	*****	3.5	4.3	20.9	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90518 W\*168PH002 (1.10E17) LOW RESISTIVITY W133 00 000  
 \*SOL12 1 /10/80 AMI: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.557	19.81	-6.534	1.91	-.77	.740	9.54	.00	.00	.00
1B	22.00	.556	20.32	-8.079	1.45	.14	.758	9.81	4.29	.00	.00
2B.*	22.10	.548	19.53	-5.556	2.35	-1.18	.709	9.08	3.00	.00	.00
3B	21.90	.552	20.23	-8.163	1.42	.24	.757	9.67	4.16	.00	.00
4B	22.20	.552	20.50	-8.069	1.44	.13	.758	9.83	4.29	.00	.00
1C	21.70	.562	17.80	-4.261	3.61	-.76	.605	7.80	.52	.00	.00
2C	21.10	.587	19.47	-7.819	1.60	-.38	.767	10.05	2.34	.00	.00
3C	21.40	.569	18.12	-4.628	3.21	-1.34	.650	8.37	.00	.00	.00
4C	21.60	.567	18.30	-4.875	2.95	-.08	.634	8.21	.65	.00	.00
6C	21.50	.594	20.02	-8.665	1.42	-.06	.778	10.51	2.60	.00	.00
7C	21.40	.590	19.22	-6.097	2.23	-1.34	.736	9.83	2.86	.00	.00
8C	21.30	.582	18.86	-5.590	2.48	-1.47	.715	9.37	1.56	.00	.00
9C	21.10	.567	17.86	-4.589	3.25	-1.58	.652	8.25	.91	.00	.00
10C	21.40	.582	18.60	-5.036	2.89	-1.89	.694	9.13	1.56	.00	.00
11C	21.20	.582	18.99	-6.069	2.21	-1.11	.728	9.50	1.69	.00	.00
1S	21.60	.579	18.49	-4.606	3.29	-2.58	.681	9.01	1.17	.00	.00
2S	21.50	.590	19.95	-8.365	1.47	-.09	.773	10.36	2.60	.00	.00
3S	22.00	.554	19.76	-6.220	2.03	-.82	.729	9.40	4.16	.00	.00
4S	21.50	.590	19.33	-6.193	2.18	-1.14	.735	9.86	2.34	.00	.00
1T	20.80	.594	19.21	-7.811	1.62	-.56	.772	10.09	2.86	.00	.00
2T	21.30	.576	17.79	-4.194	3.81	-2.96	.652	8.46	1.04	.00	.00
3T	21.30	.581	18.49	-4.962	2.95	-2.12	.695	9.09	1.17	.00	.00
4T	21.20	.570	18.14	-4.805	3.04	-1.45	.665	8.50	.91	.00	.00
5T	21.40	.585	19.31	-6.394	2.07	-.93	.737	9.76	2.08	.00	.00
6T	21.30	.585	19.03	-5.936	2.29	-1.28	.727	9.58	1.82	.00	.00
AVERAGES: 90518 BASELINE W133 00 000											
	22.03	.553	20.35	-8.104	1.43	.17	.758	9.77	4.25	.00	.00
STD	.13	.002	.11	.042	.01	.05	.001	.07	.06	*	*
90518 W*168PH002 (1.10E17) LOW RESISTIVITY											
	21.38	.579	18.84	-5.856	2.53	-1.20	.706	9.26	1.74	.00	.00
STD	.25	.011	.69	1.343	.71	.77	.049	.76	.97	*	*
PERCENT OF BASELINE											
	97.0	104.7	92.6	127.7	176	*****	93.2	94.8	41.0	*****	*****
STDZ	1.7	2.3	3.9	17.0	51	787.4	6.6	8.5	23.9	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90430 W\*169PH004 (1.36E17) LOW RESISTIVITY W133 00 000  
 \*SOL12 1 /10/80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.562	19.47	-5.622	2.37	-1.74	.728	9.48	.00	.00	.00
1B.*	21.40	.553	18.92	-5.661	2.31	-.95	.706	8.83	2.60	.00	.00
2B*	22.00	.550	19.29	-5.430	2.44	-.89	.693	8.87	2.34	.00	.00
3B	22.00	.556	19.92	-6.685	1.85	-.41	.734	9.50	4.29	.00	.00
4B	21.90	.554	19.94	-6.946	1.75	-.46	.745	9.56	3.64	.00	.00
5B	21.90	.554	19.74	-6.432	1.94	-.61	.731	9.38	3.38	.00	.00
1C	21.30	.576	18.51	-5.109	2.80	-1.48	.687	8.91	1.69	.00	.00
2C	21.10	.587	19.24	-6.905	1.87	-.95	.756	9.91	3.90	.00	.00
3C	21.00	.570	17.97	-4.758	3.09	-1.73	.669	8.47	1.69	.00	.00
4C	21.10	.584	18.38	-5.116	2.84	-1.79	.695	9.05	2.60	.00	.00
5C	21.30	.570	18.15	-4.660	3.19	-1.83	.665	8.54	1.56	.00	.00
6C	21.00	.571	17.89	-4.542	3.33	-2.58	.674	8.55	1.56	.00	.00
7C	20.90	.573	17.96	-4.737	3.13	-2.32	.683	8.64	1.56	.00	.00
8C	21.10	.583	19.08	-6.535	2.00	-.80	.738	9.61	2.34	.00	.00
9C	21.20	.552	17.91	-4.743	3.00	-.52	.636	7.88	.78	.00	.00
10C	21.00	.573	18.27	-5.167	2.74	-1.35	.687	8.74	1.56	.00	.00
11C	21.40	.584	19.27	-6.308	2.10	-.95	.734	9.71	2.86	.00	.00
1S	20.90	.582	18.39	-5.277	2.70	-2.25	.717	9.23	3.00	.00	.00
2S	21.20	.563	17.87	-4.588	3.23	-1.19	.642	8.11	.91	.00	.00
3S	21.30	.577	18.63	-5.247	2.70	-1.55	.698	9.07	1.82	.00	.00
4S	21.40	.582	19.19	-6.116	2.19	-1.05	.729	9.60	2.73	.00	.00
5S	21.10	.575	18.52	-5.343	2.62	-1.56	.703	9.02	1.92	.00	.00
6S	21.20	.560	18.07	-4.812	2.98	-.98	.654	8.21		.00	.00
1T	21.50	.589	19.89	-8.061	1.54	-.23	.769	10.30	5	.00	.00
2T	21.20	.580	18.66	-5.411	2.59	-1.53	.706	9.19	2.5	.00	.00
3T*	21.40	.541	17.72	-4.575	3.11	.28	.603	7.38	.52	.00	.00
4T	21.40	.567	18.22	-4.849	2.98	-.66	.648	8.31	.52	.00	.00
5T	21.40	.571	18.64	-5.327	2.61	-.69	.679	8.77	1.43	.00	.00
6T	21.40	.588	19.81	-8.171	1.51	-.06	.767	10.20	4.94	.00	.00
AVERAGES: 90430 BASELINE W133 00 000											
	21.93	.555	19.87	-6.688	1.35	-.49	.737	9.48	3.77	.00	.00
STD	.05	.001	.09	.210	.08	.09	.006	.08	.38	*	*
90430 W*169PH004 (1.36E17) LOW RESISTIVITY											
	21.20	.575	18.57	-5.536	2.62	-1.28	.697	9.00	2.17	.00	.00
STD	.17	.009	.59	1.031	.52	.65	.038	.65	1.21	*	*
PERCENT OF BASELINE											
	96.7	103.7	93.5	117.2	142	-57.7	94.6	94.9	57.5	*****	*****
STDZ	1.0	1.8	3.4	18.5	25	198.8	6.0	7.1	41.2	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90503 W\*170PH005 (1.5E17) LOW RESISTIVITY W133 00 000  
 \*SOL12 1 /10/80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.560	19.74	-6.252	2.04	-1.14	.740	9.60	.00	.00	.00
1B*	22.70	.542	18.97	-4.315	3.39	-1.73	.641	8.34	1.82	.00	.00
2B	22.40	.547	20.38	-7.107	1.67	.09	.733	9.49	3.64	.00	.00
3B	22.60	.553	20.65	-7.336	1.62	.09	.740	9.78	5.20	.00	.00
4B	22.90	.551	20.93	-7.438	1.59	.29	.736	9.82	4.42	.00	.00
5B.*	22.10	.547	19.04	-4.827	2.88	-1.76	.681	8.71	2.60	.00	.00
1C	22.10	.563	18.94	-4.722	3.07	-1.83	.674	8.87	3.64	.00	.00
2C	22.50	.576	19.73	-5.321	2.62	-1.33	.700	9.59	7.15	.00	.00
3C	22.30	.579	20.28	-6.908	1.84	-.38	.741	10.12	11.00	.00	.00
4C*	21.60	.563	18.48	-4.751	3.05	-1.61	.668	8.59	2.34	.00	.00
5C	22.10	.571	18.89	-4.658	3.18	-1.97	.672	8.97	3.64	.00	.00
6C	22.20	.564	18.71	-4.395	3.44	-2.13	.655	8.68	3.00	.00	.00
7C	22.10	.569	19.43	-5.408	2.53	-1.25	.702	9.33	4.81	.00	.00
8C	21.90	.573	19.32	-5.477	2.51	-1.42	.710	9.42	4.55	.00	.00
9C	22.10	.582	19.87	-6.264	2.11	-.80	.729	9.92	5.85	.00	.00
10C	22.20	.562	18.92	-4.770	3.01	-1.05	.655	8.65	2.34	.00	.00
11C	22.10	.571	19.19	-4.996	2.86	-1.79	.692	9.23	4.81	.00	.00
1S	21.80	.574	19.58	-6.256	2.09	-.72	.726	9.61	4.55	.00	.00
2S	21.90	.580	19.93	-6.934	1.84	-.49	.745	10.01	4.94	.00	.00
3S	22.10	.583	20.22	-7.264	1.74	-.31	.750	10.22	8.45	.00	.00
4S	22.40	.577	19.61	-5.274	2.66	-1.37	.698	9.54	5.20	.00	.00
5S	21.60	.574	19.15	-5.677	2.39	-1.24	.714	9.37	5.20	.00	.00
6S	21.70	.577	19.78	-7.077	1.78	-.29	.743	9.84	5.60	.00	.00
1T	21.80	.565	18.60	-4.544	3.27	-2.51	.677	8.82	3.00	.00	.00
2T	21.50	.574	19.17	-5.838	2.30	-1.31	.724	9.45	8.71	.00	.00
3T	21.80	.577	19.47	-5.936	2.25	-1.11	.724	9.63	6.50	.00	.00
4T	21.50	.577	19.05	-5.618	2.44	-1.45	.717	9.40	6.11	.00	.00
5T	21.52	.577	19.05	-5.618	2.44	-1.45	.717	9.40	6.50	.00	.00
6T	21.70	.573	19.08	-5.367	2.58	-1.51	.705	9.28	7.28	.00	.00
AVERAGES: 90503 BASELINE W133 00 000											
	22.63	.550	20.65	-7.293	1.63	.15	.736	9.70	4.42	.00	.00
STD	.21	.002	.22	.139	.04	.09	.003	.15	.64	*	*
90503 W*170PH005 (1.5E17) LOW RESISTIVITY											
	21.95	.574	19.36	-5.651	2.50	-1.26	.708	9.42	5.58	.00	.00
STD	.29	.006	.46	.826	.48	.58	.027	.43	2.02	*	*
PERCENT OF BASELINE											
	97.0	104.2	93.8	122.5	153	*****	96.1	97.2	126.3	*****	*****
STD%	2.2	1.5	3.3	13.0	34	*****	4.1	6.0	70.6	*****	*****



TABLE 16 SOLAR CELL I-V DATA (Cont.)

90628 W171W002 (1.5E12) W133 00 000  
 \*SOL12 1 /10/80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.561	19.80	-6.449	1.96	-.97	.743	9.65	.00	.00	.00
1B	21.80	.558	20.19	-8.284	1.41	.14	.763	9.82	4.55	.00	.00
2B	21.90	.561	20.34	-8.660	1.34	.40	.763	9.92	4.94	.00	.00
3B*	21.90	.557	17.65	-4.798	2.96	3.13	.543	7.01	3.38	.00	.00
4B	21.80	.555	19.70	-6.608	1.87	-.38	.730	9.34	3.64	.00	.00
1C	20.90	.544	19.03	-7.023	1.70	-.30	.742	8.92	2.21	.00	.00
2C	21.10	.544	19.19	-6.931	1.73	-.44	.743	9.02	2.21	.00	.00
3C	21.30	.541	19.33	-6.817	1.76	-.43	.739	9.01	2.21	.00	.00
4C	21.10	.541	19.06	-6.602	1.83	-.44	.731	8.83	2.21	.00	.00
5C	21.10	.541	19.21	-6.987	1.70	-.38	.743	8.97	2.21	.00	.00
6C	21.30	.544	19.37	-6.938	1.73	-.37	.741	9.08	2.21	.00	.00
7C	21.40	.541	19.43	-6.856	1.74	-.38	.739	9.05	2.08	.00	.00
8C	21.00	.540	18.99	-6.555	1.85	-.72	.738	8.85	1.69	.00	.00
9C	21.90	.544	19.94	-7.022	1.69	-.29	.742	9.35	2.21	.00	.00
10C	21.60	.544	19.64	-6.981	1.71	-.18	.737	9.16	2.34	.00	.00
11C	21.80	.544	19.81	-6.913	1.73	-.31	.739	9.27	2.08	.00	.00
1S	21.20	.545	19.06	-6.263	1.98	-.86	.731	8.93	2.21	.00	.00
2S	21.40	.548	19.59	-7.318	1.62	-.34	.753	9.34	2.73	.00	.00
3S	21.90	.547	19.89	-6.906	1.74	-.23	.736	9.33	2.60	.00	.00
4S	21.50	.546	19.59	-7.077	1.69	-.24	.742	9.21	2.60	.00	.00
5S	21.60	.546	18.95	-5.976	2.12	.99	.662	8.25	2.60	.00	.00
6S	21.50	.545	19.58	-7.023	1.70	-.33	.743	9.21	2.73	.00	.00
1T	21.00	.538	18.67	-5.737	2.21	-1.31	.720	8.61	1.69	.00	.00
2T	21.00	.540	18.63	-5.657	2.27	-1.42	.719	8.63	1.69	.00	.00
3T	20.90	.540	18.61	-5.800	2.19	-1.30	.723	8.63	1.69	.00	.00
4T	21.00	.540	19.02	-6.663	1.81	-.61	.739	8.86	1.95	.00	.00
5T	21.20	.540	19.17	-6.561	1.85	-.69	.738	8.93	2.08	.00	.00
6T	20.90	.540	18.79	-6.273	1.96	-.83	.730	8.71	1.95	.00	.00
AVERAGES: 90628 BASELINE W133 00 000											
	21.83	.558	20.07	-7.851	1.54	.05	.752	9.69	4.38	.00	.00
STD	.05	.002	.27	.892	.24	.32	.016	.25	.54	*	*
90628 W171W002 (1.5E12)											
	21.29	.543	19.24	-6.647	1.84	-.50	.734	8.96	2.18	.00	.00
STD	.31	.003	.39	.464	.19	.47	.017	.27	.31	*	*
PERCENT OF BASELINE											
	97.5	97.3	95.9	115.3	119	*****	97.5	92.5	49.8	*****	*****
STD%	1.6	.9	3.3	16.2	32	*****	4.4	5.2	14.3	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90713 W172CU006 (24E15) THREE INCH MATERIAL W133 00 000  
 \*SOL14 1 /10/80 AM1: P0=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.562	20.03	-7.170	1.70	-.51	.754	9.81	.00	.00	.00
11B.*	22.90	.559	20.33	-5.642	2.33	-1.32	.720	9.74	3.00	.00	.00
12B	22.90	.560	20.51	-6.423	1.96	.20	.705	9.57	3.12	.00	.00
13B	22.90	.560	20.99	-7.363	1.63	-.29	.754	10.22	4.42	.00	.00
14B	22.60	.559	20.76	-7.572	1.58	-.18	.756	10.10	4.29	.00	.00
21B	22.70	.554	20.35	-6.146	2.06	-.74	.725	9.64	3.51	.00	.00
22B	22.90	.557	20.99	-7.411	1.61	-.18	.751	10.14	4.29	.00	.00
23B*	20.30	.548	16.10	-3.289	5.69	-7.83	.638	7.51	2.08	.00	.00
24B	22.60	.555	20.55	-6.881	1.77	-.43	.743	9.85	3.90	.00	.00
31B.*	23.50	.553	20.66	-5.349	2.48	-1.30	.705	9.69	.13	.00	.00
32B.*	23.10	.550	20.34	-5.684	2.27	-.28	.689	9.25	2.34	.00	.00
33B	23.30	.557	21.28	-7.093	1.70	-.43	.751	10.30	1.30	.00	.00
34B	23.20	.557	21.31	-7.541	1.58	-.16	.755	10.31	2.21	.00	.00
>THIS IS THE SEED WAFER											
1S	20.70	.556	18.77	-6.704	1.85	-.70	.742	9.03	2.86	.00	.00
2S.*	20.80	.543	15.31	-2.707	8.52	*****	.586	7.00	1.04	.00	.00
3S	21.50	.554	18.96	-5.386	2.49	-1.75	.715	9.00	3.00	.00	.00
4S.*	19.80	.511	13.81	-3.693	4.28	4.40	.433	4.63	.00	.00	.00
5S	22.40	.539	18.80	-4.356	3.33	-1.87	.648	8.27	1.20	.00	.00
6S	21.20	.525	16.89	-3.842	4.04	-1.59	.584	6.87	.52	.00	.00
7S	22.60	.556	20.56	-6.837	1.79	-.58	.746	9.92	3.00	.00	.00
8S	23.40	.560	21.54	-7.722	1.54	-.09	.758	10.50	3.51	.00	.00
9S	22.30	.560	20.47	-7.369	1.64	-.57	.763	10.07	3.64	.00	.00
10S	22.50	.556	20.28	-6.264	2.01	-1.03	.739	9.77	2.86	.00	.00
11S	22.50	.559	20.60	-7.131	1.70	-.71	.760	10.11	3.90	.00	.00
13S.*	16.30	.379	11.81	-17.086	.41	14.25	.576	2.46	3.90	.00	.00
14S	22.90	.558	21.34	-8.805	1.30	.13	.775	10.48	3.90	.00	.00
15S	22.30	.556	20.07	-6.179	2.05	-1.17	.739	9.69	3.25	.00	.00
16S	22.90	.558	21.05	-7.664	1.55	-.05	.754	10.19	3.90	.00	.00
17S	22.90	.558	21.15	-7.947	1.48	-.13	.764	10.33	3.64	.00	.00
18S	22.80	.560	21.19	-8.497	1.36	-.00	.773	10.44	3.64	.00	.00
19S	22.40	.560	20.09	-6.059	2.12	-1.14	.733	9.72	3.64	.00	.00
20S	22.80	.560	21.19	-8.497	1.36	-.00	.773	10.44	3.64	.00	.00
21S	22.40	.558	20.69	-7.897	1.49	-.26	.768	10.15	3.90	.00	.00
22S	22.50	.556	20.68	-7.485	1.59	-.43	.762	10.08	3.90	.00	.00
>THIS IS THE CENTER WAFER											
1C	21.70	.541	18.46	-4.653	3.02	-1.51	.659	8.19	1.04	.00	.00
2C	22.60	.553	20.46	-6.635	1.85	-.51	.736	9.73	1.04	.00	.00
3C	24.00	.553	21.04	-5.256	2.54	-1.32	.701	9.85	2.30	.00	.00
4C.*	26.80	.538	20.74	-3.262	5.29	-3.32	.579	8.83	2.30	.00	.00
5C.*	28.20	.552	21.64	-2.916	6.66	-6.28	.605	9.96	2.21	.00	.00
6C	21.90	.554	20.16	-7.694	1.53	-.22	.760	9.75	3.12	.00	.00
>THIS IS THE TANG WAFER											
1T	20.80	.550	18.67	-6.480	1.91	-.01	.713	8.62	2.34	.00	.00
2T	22.50	.547	18.93	-4.364	3.36	-2.06	.654	8.51	1.43	.00	.00
3T	21.30	.549	19.05	-6.286	1.99	-.12	.709	8.77	2.47	.00	.00
4T	20.30	.550	18.43	-6.681	1.86	-1.00	.749	8.95	3.00	.00	.00
5T	23.50	.556	20.64	-5.273	2.55	-1.51	.707	9.77	3.25	.00	.00
6T	21.60	.558	19.95	-7.906	1.49	-.25	.767	9.77	3.64	.00	.00
7T	21.90	.556	20.24	-7.955	1.48	-.29	.769	9.91	.39	.00	.00
9T	21.90	.556	19.65	-6.173	2.06	-.84	.727	9.37	3.25	.00	.00

TABLE 16 SOLAR CELL I-V DATA (Cont.)

10T	21.90	.558	20.16	-7.691	1.55	-.21	.760	9.82	3.25	.00	.00
11T	21.60	.555	19.90	-7.730	1.53	-.32	.764	9.69	3.00	.00	.00
12T	22.30	.555	20.37	-7.148	1.69	-.38	.750	9.81	3.51	.00	.00
13T	21.50	.556	19.67	-7.171	1.69	-.59	.756	9.56	3.51	.00	.00
14T.*	17.20	.483	11.11	-12.063	.78	19.11	.334	2.93	.00	.00	.00
>THIS IS WAFER A											
1	12.50	.527	10.81	-5.320	2.58	-1.58	.673	4.69	1.30	.00	.00
2	20.80	.537	18.42	-5.699	2.73	-1.02	.709	8.38	3.38	.00	.00
4.*	18.60	.542	15.81	-4.441	3.34	-3.62	.681	7.26	1.69	.00	.00
5	20.90	.544	18.72	-6.045	2.08	-1.16	.730	8.78	2.08	.00	.00
6	20.10	.522	17.37	-5.039	2.61	-1.29	.677	7.51	1.04	.00	.00
8	16.80	.529	13.97	-4.373	3.40	-2.29	.634	5.96	1.17	.00	.00
9	21.80	.548	19.74	-6.565	1.87	-.77	.741	9.37	2.60	.00	.00
10	20.60	.547	18.34	-5.824	2.21	-1.25	.721	8.59	2.34	.00	.00
12.*	13.70	.515	11.06	-4.089	3.86	-3.20	.604	4.51	.78	.00	.00
>THIS IS WAFER B											
1	22.40	.557	20.76	-8.364	1.39	.13	.766	10.10	3.51	.00	.00
2	22.40	.553	20.62	-7.777	1.51	-.03	.756	9.91	3.25	.00	.00
3	22.40	.554	20.20	-6.596	1.87	-.13	.722	9.48	2.86	.00	.00
4	22.50	.552	20.44	-6.831	1.78	-.43	.741	9.73	3.00	.00	.00
5	22.40	.551	20.22	-6.417	1.93	-.81	.738	9.63	3.00	.00	.00
6	11.70	.536	10.24	-5.483	2.52	-2.84	.700	4.64	1.95	.00	.00
7	22.30	.552	20.21	-6.686	1.83	-.51	.738	9.61	2.86	.00	.00
8	21.60	.553	19.84	-7.495	1.58	-.36	.759	9.59	3.51	.00	.00
9	22.30	.549	19.79	-5.627	2.31	-1.36	.719	9.31	2.34	.00	.00
10	20.80	.539	18.48	-5.721	2.23	-1.36	.720	8.54	1.82	.00	.00
11	21.50	.552	19.67	-7.187	1.67	-.55	.755	9.48	3.25	.00	.00
12	21.40	.552	19.56	-7.234	1.66	-.33	.750	9.37	3.25	.00	.00
>THIS IS WAFER C											
1	20.70	.550	18.67	-6.548	1.89	-.41	.727	8.76	2.60	.00	.00
2	20.00	.543	17.24	-4.964	2.78	-1.49	.676	7.76	1.82	.00	.00
4	22.30	.547	19.51	-5.305	2.50	-1.12	.694	8.95	2.21	.00	.00
5	22.60	.552	20.55	-6.945	1.74	-.27	.740	9.76	3.00	.00	.00
6	21.90	.549	19.64	-6.260	1.99	-.46	.719	9.15	3.00	.00	.00
8	21.70	.539	18.84	-5.047	2.66	-1.48	.687	8.50	1.56	.00	.00
9	22.10	.546	19.57	-5.678	2.27	-.94	.708	9.04	2.34	.00	.00
10	17.60	.537	14.71	-4.416	3.37	-2.31	.642	6.42	1.69	.00	.00
11	18.30	.530	15.52	-4.732	2.96	-1.40	.651	6.68	1.43	.00	.00
12	18.80	.540	16.24	-5.098	2.67	-1.21	.674	7.23	1.43	.00	.00
AVERAGES: 90713 BASELINE W133 00 000											
	22.89	.557	20.84	-7.054	1.74	-.28	.742	10.02	3.38	.00	.00
STD	.24	.002	.33	.498	.17	.25	.017	.28	1.05	*	*
90713 W172CU006 (24E15) THREE INCH MATERIAL											
	21.39	.550	19.17	-6.429	2.08	-.83	.725	9.05	2.67	.00	.00
STD	2.12	.009	2.19	1.204	.60	.67	.041	1.28	.93	*	*
PERCENT OF BASELINE											
	93.5	98.6	92.0	108.9	120	*****	97.6	90.3	78.9	*****	*****
STDZ	10.4	2.0	12.1	24.7	49	742.5	7.9	15.6	60.6	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90712 W173FE008 (5.1E14) THREE INCH MATERIAL W133 00 000  
 \*SCL14 1 /10/80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.560	19.61	-5.982	2.16	-1.23	.731	9.48	.00	.00	.00
11B.*	22.00	.555	19.56	-5.944	2.16	-.49	.706	9.12	4.29	.00	.00
12B	22.50	.555	20.39	-6.676	1.84	-.52	.738	9.75	4.16	.00	.00
21B	22.40	.555	20.22	-6.628	1.86	-.16	.724	9.52	4.29	.00	.00
22B	22.40	.555	20.16	-6.410	1.95	-.46	.726	9.54	4.55	.00	.00
3B*	26.10	.550	20.40	-3.179	5.72	-5.11	.608	9.23	1.82	.00	.00
>THIS IS THE SEED WAFER											
11S	21.40	.548	19.39	-6.958	1.73	.16	.725	8.99	2.86	.00	.00
12S	21.30	.546	19.03	-5.979	2.12	-1.00	.723	8.89	2.34	.00	.00
21S	21.00	.546	18.93	-6.451	1.91	-.61	.731	8.86	2.60	.00	.00
22S	20.70	.544	18.31	-5.520	2.37	-1.63	.717	8.54	2.47	.00	.00
23S	20.80	.543	18.55	-5.869	2.17	-1.22	.723	8.64	2.73	.00	.00
24S	21.00	.543	18.94	-6.465	1.89	-.65	.732	8.83	3.00	.00	.00
25S	20.30	.541	18.33	-6.642	1.83	-.34	.729	8.46	2.47	.00	.00
31S	21.70	.545	19.54	-6.457	1.90	-.42	.726	9.08	2.21	.00	.00
32S	21.50	.546	19.51	-6.870	1.75	-.27	.736	9.13	2.34	.00	.00
33S	21.40	.544	19.34	-6.647	1.83	-.36	.731	9.00	2.34	.00	.00
41S.*	21.60	.544	16.61	-5.735	2.23	8.00	.461	5.73	1.69	.00	.00
42S	21.70	.538	19.39	-6.162	2.00	-.38	.713	8.80	2.21	.00	.00
>THIS IS THE TANG WAFER											
11T	17.60	.507	14.36	-4.058	3.67	-2.69	.618	5.83	.39	.00	.00
12T	19.00	.520	16.56	-5.415	2.35	-.62	.678	7.09	.65	.00	.00
13T	17.60	.507	15.36	-5.478	2.27	-.68	.681	6.42	.52	.00	.00
14T	18.10	.511	15.83	-5.501	2.27	-.76	.685	6.70	.52	.00	.00
21T	19.50	.522	16.63	-4.807	2.82	-1.26	.658	7.08	.65	.00	.00
22T.*	18.00	.503	14.50	-3.793	4.09	-3.86	.616	5.90	.39	.00	.00
23T	17.90	.504	15.20	-4.722	2.83	-1.64	.657	6.27	.52	.00	.00
24T	18.80	.514	16.49	-5.579	2.23	-.64	.688	7.03	.65	.00	.00
25T.*	17.60	.500	13.81	-3.388	5.08	-6.66	.611	5.68	.39	.00	.00
31T	19.00	.517	16.13	-4.620	2.98	-2.02	.662	6.88	.52	.00	.00
32T	19.00	.517	16.70	-5.683	2.18	-.45	.688	7.15	.65	.00	.00
33T	18.60	.512	15.53	-4.348	3.27	-2.26	.643	6.47	.52	.00	.00
41T	19.00	.516	16.37	-5.203	2.48	-.35	.659	6.83	.65	.00	.00
42T	18.10	.508	15.59	-5.219	2.44	-.34	.658	6.39	.52	.00	.00
43T	19.20	.518	16.99	-5.838	2.10	-.60	.701	7.37	.65	.00	.00
44T.*	17.40	.498	13.99	-3.765	4.14	-4.26	.617	5.66	.39	.00	.00
>THIS IS THE CENTER WAFER											
11C	19.30	.521	16.84	-5.359	2.39	-.97	.686	7.29	.65	.00	.00
12C	19.90	.526	17.33	-5.269	2.46	-1.08	.685	7.58	.78	.00	.00
13C.*	18.00	.511	14.70	-3.828	4.09	-4.84	.642	6.25	.50	.00	.00
21C	19.80	.526	17.20	-5.301	2.44	-.66	.675	7.43	.72	.00	.00
22C	18.50	.516	16.31	-5.722	2.16	-.71	.697	7.03	1.43	.00	.00
23C	20.40	.527	18.16	-6.073	2.01	-.33	.705	8.02	.91	.00	.00
24C	18.90	.514	16.35	-5.224	2.45	-.68	.669	6.87	.65	.00	.00
25C	19.10	.514	16.63	-5.297	2.40	-1.04	.684	7.10	.65	.00	.00
31C	19.50	.517	17.18	-5.621	2.21	-.88	.698	7.45	.65	.00	.00
32C	19.90	.525	17.00	-4.853	2.78	-1.14	.659	7.28	.91	.00	.00
33C	20.10	.529	17.75	-5.605	2.26	-1.17	.707	7.95	.91	.00	.00
41C	19.00	.519	16.74	-5.714	2.17	-.59	.694	7.24	.65	.00	.00
42C	19.20	.519	17.04	-5.989	2.03	-.37	.701	7.39	.65	.00	.00
43C.*	18.70	.517	13.78	-2.925	7.06	-8.77	.560	5.72	8.06	.00	.00
44C	18.90	.514	16.60	-5.556	2.24	-.87	.693	7.12	8.06	.00	.00
45C	20.30	.525	17.93	-5.688	2.19	-.80	.701	7.90	8.06	.00	.00

TABLE 16 SOLAR CELL I-V DATA (Cont.)

>THIS IS WAFER A											
1	20.90	.541	18.44	-5.667	2.27	-.74	.699	8.36	1.69	.00	.00
2	21.00	.535	18.71	-5.968	2.08	-.74	.714	8.49	1.56	.00	.00
3.*	21.10	.537	16.24	-3.380	5.24	-3.62	.567	6.80	1.56	.00	.00
4	20.80	.540	18.71	-6.420	1.90	-.46	.724	8.60	2.21	.00	.00
5	20.70	.536	18.60	-6.334	1.93	-.61	.726	8.51	1.82	.00	.00
6	20.50	.536	18.33	-6.190	1.99	-.49	.715	8.31	1.69	.00	.00
7	20.30	.537	18.32	-6.468	1.88	-.80	.736	8.48	1.82	.00	.00
8	20.30	.538	18.40	-6.691	1.80	-.71	.742	8.57	2.08	.00	.00
>THIS IS WAFER B											
1	20.50	.526	16.70	-4.373	3.27	.28	.585	6.68	.91	.00	.00
2.*	19.00	.510	13.39	-4.579	2.98	8.60	.415	4.25	.91	.00	.00
3.*	20.70	.528	15.79	-3.510	4.81	-1.72	.542	6.26	.91	.00	.00
4	20.30	.527	17.96	-5.713	2.19	-.89	.705	7.98	1.04	.00	.00
5	19.20	.523	16.89	-5.535	2.29	-1.11	.699	7.43	.82	.00	.00
6	19.20	.519	16.77	-5.842	2.10	.86	.659	6.95	.78	.00	.00
7	19.90	.520	17.43	-5.384	2.36	-1.17	.695	7.60	.75	.00	.00
8	18.90	.519	16.44	-5.097	2.57	-1.91	.694	7.20	.75	.00	.00
9	18.00	.507	15.18	-4.766	2.80	-.69	.636	6.14	5.00	.00	.00
10	18.20	.509	15.73	-5.177	2.47	-.93	.671	6.57	5.00	.00	.00
>THIS IS WAFER C - METALIZATION LOOKS BAD -											
1.*	15.50	.498	10.13	-3.665	4.47	7.69	.390	3.18	.26	.00	.00
2.*	14.00	.502	10.23	-5.488	2.31	12.74	.426	3.17	.26	.00	.00
3.*	20.00	.516	15.00	-3.484	4.81	-1.10	.522	5.70	.50	.00	.00
4	20.20	.516	15.99	-4.044	3.67	.13	.559	6.16	.45	.00	.00
5	19.70	.507	16.29	-4.641	2.88	.55	.595	6.31	.39	.00	.00
6.*	19.20	.504	13.82	-3.559	4.55	1.78	.469	4.80	.10	.00	.00
7.*	17.00	.459	10.56	-2.776	7.32	-1.80	.397	3.27	.10	.00	.00
8	20.20	.491	15.87	-3.825	3.84	-.93	.563	5.91	.10	.00	.00
9	20.30	.515	16.41	-4.362	3.22	.72	.573	6.33	.65	.00	.00
10	19.30	.512	15.05	-3.800	4.09	-.86	.554	5.79	.65	.00	.00
11	18.00	.488	13.88	-4.162	3.37	2.29	.517	4.80	.43	.00	.00
12.*	17.30	.507	11.54	-3.275	5.55	2.55	.420	3.89	.38	.00	.00
AVERAGES: 90712 BASELINE W133 00 000											
	22.43	.555	20.26	-6.571	1.88	-.38	.729	9.60	4.33	.00	.00
STD	.05	.000	.10	.116	.05	.16	.006	.10	.16	*	*
90712 W173FE008 (5.1E14) THREE INCH MATERIAL											
	19.72	.524	17.16	-5.495	2.42	-.69	.679	7.45	1.55	.00	.00
STD	1.09	.014	1.36	.777	.54	.74	.051	1.01	1.60	*	*
PERCENT OF BASELINE											
	87.9	94.3	84.7	116.4	128	17.6	93.1	77.6	35.7	*****	*****
STD%	5.1	2.5	7.2	13.5	33	353.4	7.8	11.4	39.6	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90701 W174TA004 (8.4E11) W133 00 000

\*SOL12 1 /10/80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.559	19.80	-6.511	1.92	-.77	.739	9.57	.00	.00	.00
1B*	22.10	.550	19.32	-5.271	2.54	-1.18	.693	8.90	3.12	.00	.00
2B	21.80	.554	19.91	-7.311	1.64	.04	.740	9.46	4.81	.00	.00
3B	22.10	.552	20.26	-7.619	1.55	.22	.743	9.59	4.94	.00	.00
4B	22.00	.555	20.07	-7.195	1.67	-.12	.742	9.58	5.20	.00	.00
5B	22.10	.553	20.21	-7.346	1.62	-.07	.745	9.63	5.20	.00	.00
1C	19.80	.538	17.85	-6.668	1.81	-.05	.720	8.11	1.09	.00	.00
3C	20.30	.539	18.34	-6.836	1.75	.16	.720	8.33	3.51	.00	.00
4C	20.00	.538	18.05	-6.755	1.78	.09	.719	8.19	1.30	.00	.00
5C	20.20	.539	18.27	-6.874	1.74	.15	.722	8.31	1.43	.00	.00
6C	20.00	.537	18.01	-6.719	1.79	.22	.714	8.11	1.30	.00	.00
7C	20.10	.539	17.67	-5.319	2.49	-1.89	.711	8.14	1.17	.00	.00
8C	19.60	.529	16.80	-5.019	2.67	-.66	.656	7.20	1.43	.00	.00
9C	20.00	.529	17.01	-4.753	2.89	-1.23	.654	7.32	.78	.00	.00
10C	19.80	.532	17.08	-5.046	2.66	-1.15	.672	7.49	1.43	.00	.00
11C	20.30	.543	18.48	-7.291	1.62	.35	.729	8.50	.91	.00	.00
1S	20.10	.536	17.75	-5.785	2.19	-.42	.694	7.91	1.04	.00	.00
2S	20.10	.540	18.21	-6.980	1.71	.21	.723	8.30	1.43	.00	.00
3S	20.10	.538	17.89	-6.132	2.03	-.11	.701	8.01	1.43	.00	.00
4S	20.30	.536	17.85	-5.649	2.26	-.46	.689	7.92	1.04	.00	.00
5S	20.30	.536	18.26	-6.665	1.80	.23	.712	8.19	1.30	.00	.00
6S	20.20	.538	18.16	-6.527	1.86	-.08	.716	8.23	1.43	.00	.00
1T	20.10	.538	17.89	-6.107	2.04	-.21	.703	8.04	1.30	.00	.00
2T	19.90	.535	17.88	-6.595	1.83	.21	.710	7.99	1.04	.00	.00
3T	20.00	.537	18.14	-7.141	1.65	.51	.719	8.17	1.30	.00	.00
4T	20.10	.537	18.18	-6.982	1.70	.44	.716	8.18	1.30	.00	.00
5T	20.00	.532	17.74	-5.965	2.08	-.32	.699	7.87	.91	.00	.00
6T	20.30	.538	18.43	-7.204	1.63	.48	.722	8.34	1.30	.00	.00
AVERAGES: 90701 BASELINE W133 00 000											
	22.00	.554	20.11	-7.368	1.62	.02	.743	9.56	5.04	.00	.00
STD	.12	.001	.14	.155	.05	.13	.002	.07	.17	*	*
90701 W174TA004 (8.4E11)											
	20.07	.537	17.91	-6.319	2.00	-.16	.706	8.04	1.33	.00	.00
STD	.18	.003	.44	.747	.37	.60	.021	.32	.51	*	*
PERCENT OF BASELINE											
	91.2	96.9	89.0	114.2	123	*****	95.0	84.1	26.3	*****	*****
STD%	1.3	.8	2.8	12.2	27	*****	3.0	4.0	11.4	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90702 W175W003 (2.9E11) W133 00 000

\*SOL12 1 /10/80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.557	19.66	-6.124	2.08	-1.07	.733	9.45	.00	.00	.00
1B	21.90	.546	19.78	-6.779	1.78	.14	.720	9.10	3.64	.00	.00
2B	22.10	.548	20.12	-7.121	1.67	-.02	.737	9.44	4.16	.00	.00
3B	22.10	.548	20.28	-7.676	1.52	.20	.746	9.55	4.55	.00	.00
4B	22.10	.547	20.09	-7.028	1.70	-.00	.733	9.37	4.03	.00	.00
5B	21.90	.548	19.98	-7.196	1.65	-.10	.742	9.41	3.90	.00	.00
1C	21.90	.546	19.98	-7.229	1.64	-.00	.739	9.35	3.51	.00	.00
2C	21.80	.544	19.87	-7.158	1.65	-.06	.739	9.27	3.00	.00	.00
3C	21.90	.544	19.97	-7.208	1.64	-.00	.739	9.31	2.86	.00	.00
4C	21.50	.541	19.52	-6.379	1.73	-.30	.737	9.07	2.73	.00	.00
5C	21.40	.539	19.21	-6.238	1.97	-.74	.727	8.86	2.60	.00	.00
6C	21.40	.540	19.36	-6.622	1.82	-.51	.735	8.98	2.86	.00	.00
7C	21.50	.541	19.38	-6.448	1.89	-.54	.729	8.97	2.86	.00	.00
8C	21.90	.542	19.79	-6.765	1.77	.01	.723	9.08	2.73	.00	.00
9C	21.70	.542	19.60	-6.563	1.85	-.47	.732	9.10	2.86	.00	.00
10C	21.50	.541	19.46	-6.720	1.79	-.34	.733	9.02	2.86	.00	.00
1S	21.60	.540	19.52	-6.620	1.83	-.39	.731	9.7	2.86	.00	.00
2S	21.80	.540	19.23	-5.911	2.12	.22	.683	8.50	2.60	.00	.00
3S	22.20	.543	20.18	-7.022	1.69	-.03	.734	9.35	3.00	.00	.00
4S	21.60	.541	19.42	-6.331	1.94	-.60	.727	8.98	2.60	.00	.00
1T	21.40	.542	19.12	-5.979	2.10	-1.00	.723	8.87	1.17	.00	.00
2T	21.60	.544	19.50	-6.610	1.84	-.27	.727	9.03	2.73	.00	.00
3T	21.50	.542	19.47	-6.692	1.80	-.44	.735	9.06	2.60	.00	.00
4T	21.40	.537	18.69	-5.179	2.56	-1.56	.697	8.48	1.56	.00	.00
5T	21.10	.532	18.89	-6.168	1.98	-.65	.721	8.55	1.95	.00	.00
AVERAGES: 90702 BASELINE W133 00 000											
	22.02	.547	20.05	-7.160	1.67	.04	.735	9.37	4.06	.00	.00
STD	.10	.001	.17	.294	.08	.11	.009	.15	.30	*	*
90702 W175W003 (2.9E11)											
	21.62	.541	19.48	-6.544	1.87	-.40	.727	8.99	2.63	.00	.00
STD	.25	.003	.36	.493	.21	.40	.014	.25	.52	*	*
PERCENT OF BASELINE											
	98.2	98.9	97.2	108.6	112	*****	98.8	95.9	64.8	*****	*****
STDZ	1.6	.7	2.6	10.9	19	*****	3.1	4.2	18.6	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90703 W177N/CR-MN001 (1.2E15-1.26E15) W079 00 000  
 \*SOL14 1 /10/80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	τff	OCD	PCDa	PCDb
2R*	21.90	.555	19.68	-6.195	2.04	-1.00	.733	9.43	.00	.00	.00
1B*	18.80	.529	15.95	-4.715	2.96	-1.43	.652	6.86	1.82	.00	.00
2B	21.30	.549	19.34	-6.781	1.79	-.62	.744	9.20	4.16	.00	.00
3B.*	20.60	.542	17.91	-5.092	2.66	-1.67	.692	8.17	4.42	.00	.00
1C	19.00	.526	17.21	-6.784	1.74	-.43	.735	7.77	2.34	.00	.00
2C	18.10	.519	16.05	-5.711	2.18	-1.57	.718	7.14	2.73	.00	.00
3C.*	17.90	.514	15.21	-4.353	3.29	-4.37	.691	6.73	2.73	.00	.00
4C	18.10	.516	15.72	-5.021	2.63	-2.34	.697	6.88	2.86	.00	( )
5C	17.80	.517	16.27	-7.335	1.55	-.31	.749	7.29	2.73	.00	.00
6C	17.80	.508	15.73	-5.722	2.14	-1.05	.705	6.74	2.08	.00	.00
7C	18.20	.518	16.65	-7.475	1.51	.00	.744	7.42	3.00	.00	.00
8C	18.10	.515	16.61	-7.700	1.44	.12	.747	7.37	2.73	.00	.00
9C	18.40	.517	16.68	-6.859	1.69	-.33	.734	7.39	2.60	.00	.00
10C	18.10	.517	16.58	-7.560	1.48	.02	.746	7.38	2.60	.00	.00
11C	17.80	.510	15.71	-5.673	2.17	-1.13	.704	6.76	1.56	.00	.00
1S	13.80	.505	11.59	-4.628	3.05	-2.36	.644	4.75	1.69	.00	.00
2S	19.10	.531	17.48	-7.247	1.60	-.62	.756	8.11	1.69	.00	.00
4S	18.60	.525	16.40	-5.268	2.41	-2.35	.722	7.45	2.21	.00	.00
5S	18.90	.523	17.21	-7.080	1.63	-.28	.741	7.74	2.34	.00	.00
6S	19.00	.527	17.41	-7.399	1.55	-.37	.754	7.98	2.34	.00	.00
2T	18.20	.525	16.54	-6.929	1.69	-.50	.741	7.49	2.30	.00	.00
3T	17.80	.520	15.50	-5.090	2.60	-2.39	.701	6.86	1.70	.00	.00
4T	18.50	.526	16.86	-7.158	1.62	-.22	.741	7.63	1.95	.00	.00
5T	17.80	.523	16.16	-6.970	1.67	-.29	.736	7.25	1.56	.00	.00
6T	17.80	.516	16.18	-6.996	1.64	-.38	.740	7.18	1.30	.00	.00
AVERAGES: 90703 BASELINE W079 00 000											
	21.30	.549	19.34	-6.781	1.79	-.62	.744	9.20	4.16	.00	.00
STD	.00	.000	.00	.000	.00	.00	.000	.00	.00	*	*
90703 W177N/CR-MN001 (1.2E15-1.26E15)											
	18.05	.519	16.23	-6.535	1.90	-.84	.728	7.23	2.22	.00	.00
STD	1.07	.007	1.20	.950	.45	.85	.026	.68	.49	*	*
PERCENT OF BASELINE											
	84.7	94.6	83.9	103.6	106	65.4	97.8	78.6	53.3	*****	*****
STD%	5.0	1.2	6.2	14.0	25	136.7	3.5	7.4	11.8	*****	*****



TABLE 16 SOLAR CELL I-V DATA (Cont.)

90704 W178N/MN-T1001 (8.6E14-8E13) W079 00 000  
 \*SOL14 1 /10/80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.556	19.53	-5.799	2.24	-1.38	.727	9.36	.00	.00	.00
>W079 BASELINE											
1B	21.40	.552	19.69	-7.778	1.51	.05	.753	9.41	5.85	.00	.00
2B	22.10	.556	20.47	-8.454	1.37	.42	.758	9.85	9.80	.00	.00
3B	22.00	.556	19.97	-6.870	1.78	-.25	.736	9.52	8.45	.00	.00
4B*	21.50	.544	18.15	-4.505	3.20	-1.68	.651	8.06	1.69	.00	.00
>W176 BASELINE											
1761*	21.80	.553	20.04	-7.821	1.50	.24	.748	9.54	8.45	.00	.00
1762*	22.00	.553	19.72	-6.264	2.01	-.40	.718	9.23	7.02	.00	.00
1763*	21.70	.548	19.47	-6.337	1.96	-.34	.718	9.03	5.46	.00	.00
1764*	21.90	.558	20.10	-7.704	1.54	.25	.715	9.63	9.80	.00	.00
1C*	5.90	.430	4.30	-4.166	3.70	5.26	.478	1.28	.78	.00	.00
2C	19.30	.528	17.65	-7.459	1.54	.07	.742	8.00	2.86	.00	.00
4C*	14.50	.510	12.36	-4.925	2.76	-1.67	.658	5.14	1.95	.00	.00
5C	19.50	.528	18.01	-8.385	1.32	.55	.752	8.18	3.25	.00	.00
6C	18.60	.518	16.78	-6.818	1.70	.21	.717	7.31	2.73	.00	.00
7C	19.50	.528	18.10	-8.736	1.26	.53	.760	8.28	3.90	.00	.00
1S*	16.50	.494	12.07	-3.588	4.55	.65	.489	4.21	1.95	.00	.00
2S*	19.20	.490	16.24	-5.163	2.37	1.10	.616	6.13	2.08	.00	.00
3S	19.10	.517	17.05	-6.194	1.93	-.35	.709	7.41	2.86	.00	.00
4S*	19.60	.519	16.06	-4.348	3.28	-.43	.600	6.45	3.00	.00	.00
1T	19.20	.528	17.22	-6.292	1.93	-.61	.721	7.73	1.95	.00	.00
2T	19.10	.523	17.14	-6.529	1.82	.07	.711	7.51	7.12	.00	.00
3T	19.30	.524	16.98	-5.631	2.23	-.71	.693	7.42	2.34	.00	.00
AVERAGES: 90704 BASELINE W079 00 000											
	21.83	.555	20.04	-7.701	1.55	.07	.749	9.59	8.03	.00	.00
STD	.31	.002	.32	.649	.17	.28	.009	.19	1.64	*	*
90704 W178N/MN-T1001 (8.6E14-8E13)											
	19.20	.524	17.37	-7.005	1.72	-.03	.726	7.73	2.88	.00	.00
STD	.27	.004	.46	1.026	.31	.45	.022	.36	.55	*	*
PERCENT OF BASELINE											
	87.9	94.5	86.7	109.0	110	-40.4	96.9	80.6	35.8	****	****
STD%	2.5	1.1	3.8	22.1	34	*****	4.2	5.3	15.5	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

99816 W179PH006 (73E15) W142 00 000

\*SOL14 1 /10/80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.556	19.89	-6.716	1.84	-.74	.746	9.60	.00	.00	.00
1B	20.60	.592	18.75	-6.705	1.97	-1.31	.758	9.78	1.56	.00	.00
2B	20.70	.595	19.19	-8.121	1.54	-.50	.778	10.14	1.69	.00	.00
3B	20.70	.594	19.15	-7.932	1.59	-.59	.776	10.09	1.82	.00	.00
4B	20.80	.595	19.50	-9.480	1.27	.10	.790	10.33	1.69	.00	.00
1C	21.50	.577	18.76	-5.11	2.77	-1.73	.697	9.15	.91	.00	.00
2C	21.50	.591	19.20	-	2.16	.50	.689	9.30	1.56	.00	.00
3C	21.50	.588	19.84	-7.566	1.58	-.28	.766	10.24	1.56	.00	.00
4C	21.70	.580	18.53	-4.712	3.18	-1.67	.666	8.86	.91	.00	.00
5C	21.70	.592	19.77	-6.973	1.86	-.57	.748	10.16	1.82	.00	.00
6C	21.00	.593	19.48	-8.254	1.51	-.26	.775	10.20	1.95	.00	.00
7C	21.50	.595	19.73	-7.422	1.73	-.43	.758	10.25	1.95	.00	.00
8C	21.00	.584	19.00	-6.527	2.01	-.96	.743	9.63	1.56	.00	.00
9C	21.70	.594	20.10	-8.307	1.49	.16	.764	10.41	1.95	.00	.00
10C	21.60	.591	20.01	-8.197	1.51	-.11	.769	10.39	2.08	.00	.00
11C	21.50	.583	18.91	-5.437	2.58	-1.29	.702	9.30	1.04	.00	.00
1S	21.70	.589	20.03	-7.206	1.77	-.44	.752	10.26	2.08	.00	.00
2S	22.00	.598	20.57	-9.154	1.33	.15	.782	10.88	2.21	.00	.00
3S	22.20	.594	20.19	-7.675	1.65	1.50	.706	9.84	1.95	.00	.00
4S	21.60	.585	19.17	-5.624	2.47	-1.60	.721	9.64	1.69	.00	.00
5S	21.50	.592	19.89	-8.184	1.52	.10	.762	10.26	1.82	.00	.00
1T	21.50	.599	20.21	-9.795	1.23	.14	.794	10.82	2.60	.00	.00
2T	21.80	.599	20.35	-8.930	1.38	-.01	.783	10.81	2.60	.00	.00
3T	21.60	.591	19.54	-6.481	2.05	-1.04	.744	10.04	1.82	.00	.00
4T	21.50	.591	19.07	-5.540	2.55	-1.92	.725	9.74	1.69	.00	.00
5T*	21.60	.580	17.94	-4.077	4.01	-3.23	.648	8.50	.91	.00	.00
6T	21.50	.592	19.32	-6.116	2.22	-1.34	.737	9.92	1.69	.00	.00
AVERAGES: 99816 BASELINE W142 00 000											
	20.70	.594	19.15	-8.059	1.59	-.57	.775	10.08	1.69	.00	.00
STD	.07	.001	.27	.984	.25	.50	.011	.20	.09	*	*
99816 W179PH006 (73E15)											
	21.59	.590	19.60	-7.133	1.93	-.53	.742	10.01	1.78	.00	.00
STD	.27	.006	.55	1.386	.52	.85	.034	.54	.44	*	*
PERCENT OF BASELINE											
	104.3	99.4	102.4	111.5	121	107.6	95.7	99.2	105.5	*****	*****
STDZ	1.6	1.2	4.4	30.1	56	356.5	5.8	7.4	33.2	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90817 W180\*TI001 (1.3E14) W057 OG 000  
 \*SGL14 1 /10/80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.557	19.79	-6.474	1.94	-.87	.740	9.55	.00	.00	.00
>SAMPLES 1B AND 3B HAVE BAD METALLIZATION											
1B*	17.50	.597	11.63	-4.977	3.10	15.01	.372	4.11	.78	.00	.00
2B	21.40	.587	19.31	-6.351	2.09	-1.12	.741	9.84	.78	.00	.00
3B*	17.80	.589	12.72	-4.567	3.49	9.75	.426	4.72	.78	.00	.00
5B	21.50	.593	19.50	-7.162	1.80	.61	.719	9.69	1.56	.00	.00
1C	10.50	.502	9.67	-8.220	1.34	.34	.752	4.19	.91	.00	.00
2C	10.90	.503	9.95	-7.632	1.48	.30	.737	4.27	.91	.00	.00
3C	10.80	.508	10.08	-9.348	1.15	.49	.775	4.50	.60	.00	.00
4C	10.80	.507	10.10	-9.732	1.09	1.02	.773	4.48	.78	.00	.00
5C	10.90	.507	10.15	-9.149	1.18	.61	.769	4.50	.78	.00	.00
6C	10.90	.507	10.19	-9.648	1.10	.86	.774	4.52	.78	.00	.00
7C	11.00	.508	10.24	-9.089	1.19	.47	.771	4.55	.78	.00	.00
8C	10.80	.507	10.09	-9.528	1.12	.75	.774	4.48	.78	.00	.00
10C	10.80	.505	10.04	-9.039	1.19	.49	.769	4.44	.78	.00	.00
1S	11.20	.505	10.31	-8.157	1.36	.17	.754	4.51	.78	.00	.00
2S	20.20	.530	18.07	-6.317	1.92	-.15	.710	8.04	.91	.00	.00
3S	10.80	.498	9.68	-6.549	1.82	-.84	.718	4.09	.55	.00	.00
4S	11.00	.507	10.25	-9.276	1.16	.74	.769	4.54	.55	.00	.00
5S	10.80	.479	9.18	-5.122	2.54	-1.12	.646	3.54	.55	.00	.00
6S	11.10	.507	10.36	-9.452	1.13	.90	.770	4.58	.55	.00	.00
1T	10.80	.503	9.87	-7.754	1.45	.49	.737	4.23	.91	.00	.00
2T	10.70	.507	9.90	-8.574	1.28	.41	.760	4.36	.91	.00	.00
3T	10.60	.505	9.90	-9.588	1.11	.82	.774	4.39	.91	.00	.00
4T	10.90	.505	10.04	-8.231	1.35	.32	.753	4.38	.91	.00	.00
5T	10.40	.501	9.40	-6.953	1.68	-.76	.732	4.03	.91	.00	.00
AVERAGES: 90817 BASELINE W057 00 000											
	21.45	.590	19.41	-6.757	1.95	-.26	.730	9.77	1.17	.00	.00
STD	.05	.003	.10	.405	.15	.87	.011	.08	.39	*	*
90817 W180*TI001 (1.3E14)											
	11.29	.505	10.37	-8.368	1.38	.32	.751	4.53	.78	.00	.00
STD	2.05	.008	1.79	1.264	.35	.58	.031	.84	.14	*	*
PERCENT OF BASELINE											
	52.7	85.6	53.5	76.2	71	323.3	102.9	46.4	66.4	*****	*****
STDZ	9.7	1.9	9.5	27.3	25	*****	5.9	9.0	37.8	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90820 W181CR006 (1E15) W133 00 000  
 \*SOL14 1 /10/80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.555	19.64	-6.061	2.11	-1.14	.732	9.41	.00	.00	.00
1B	22.50	.558	20.92	-8.743	1.31	.35	.766	10.18	5.20	.00	.00
2B	22.40	.552	20.55	-7.622	1.54	.12	.747	9.77	4.29	.00	.00
3B	22.20	.552	20.66	-8.762	1.30	.25	.70	9.98	4.68	.00	.00
4B	22.60	.549	20.60	-7.089	1.68	-.24	.743	9.75	4.29	.00	.00
5B	22.40	.551	20.54	-7.538	1.56	.01	.748	9.77	4.29	.00	.00
1C	20.10	.529	18.17	-6.704	1.76	-.28	.729	8.20	1.17	.00	.00
2C	20.20	.528	18.25	-6.650	1.78	-.35	.729	8.23	1.30	.00	.00
3C	20.10	.528	18.21	-6.830	1.72	-.25	.733	8.22	1.04	.00	.00
4C	20.10	.526	18.11	-6.487	1.83	-.50	.728	8.14	1.04	.00	.00
5C	20.20	.525	18.19	-6.458	1.84	-.48	.726	8.14	1.04	.00	.00
6C	20.20	.525	18.16	-6.442	1.85	-.35	.721	8.09	1.04	.00	.00
7C	20.20	.522	17.90	-5.723	2.16	-1.10	.712	7.94	.91	.00	.00
8C	20.20	.525	18.21	-6.506	1.82	-.52	.729	8.18	1.17	.00	.00
9C	20.40	.526	18.49	-6.842	1.71	-.20	.732	8.30	1.17	.00	.00
10C	20.20	.523	18.08	-6.145	1.96	-.74	.721	8.06	1.17	.00	.00
1S	20.30	.529	18.24	-6.337	1.90	-.58	.724	8.22	1.04	.00	.00
2S	20.10	.528	18.05	-6.344	1.90	-.49	.722	8.10	1.04	.00	.00
3S	20.20	.527	18.14	-6.383	1.88	-.41	.721	8.12	1.04	.00	.00
4S	20.40	.527	18.40	-6.564	1.81	-.41	.728	8.28	1.17	.00	.00
5S	20.20	.526	18.27	-6.717	1.75	-.29	.730	8.20	1.04	.00	.00
1T	20.10	.526	18.04	-6.326	1.90	-.49	.721	8.06	1.00	.00	.00
2T	20.10	.527	18.11	-6.467	1.85	-.60	.730	8.18	1.04	.00	.00
3T	20.10	.526	18.06	-6.285	1.91	-.82	.729	8.15	1.04	.00	.00
4T	20.20	.526	18.29	-6.770	1.73	-.32	.733	8.23	1.17	.00	.00
5T	20.30	.520	17.84	-5.510	2.27	-.92	.696	7.77	.78	.00	.00
6T	20.50	.525	18.47	-6.472	1.83	-.51	.728	8.28	1.17	.00	.00
AVERAGES: 90820 BASELINE W133 00 000											
	22.42	.552	20.66	-7.951	1.48	.10	.755	9.89	4.55	.00	.00
STD	.13	.003	.14	.679	.15	.20	.011	.17	.36	*	*
90820 W181CR006 (1E15)											
	20.21	.526	18.18	-6.427	1.87	-.51	.725	8.15	1.08	.00	.00
STD	.11	.002	.16	.321	.13	.22	.008	.12	.11	*	*
PERCENT OF BASELINE											
	90.1	95.2	88.0	119.2	126	*****	96.0	82.4	23.6	*****	*****
STD%	1.0	.9	1.4	11.3	23	*****	2.5	2.6	4.4	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90830 W182CR007 (4.5E14) W133 00 000

\*SOL14 1 /10/80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	EFF	OCD	PCDa	PCDb
2R*	21.90	.563	19.84	-6.567	1.92	-.89	.745	9.71	.00	.00	.00
1B	22.20	.560	20.37	-7.435	1.62	-.31	.756	9.94	3.51	.00	.00
2B	22.10	.560	20.49	-8.296	1.41	-.01	.769	10.06	4.16	.00	.00
3B	22.10	.561	20.37	-7.820	1.52	-.15	.761	9.98	4.29	.00	.00
4B	22.00	.561	20.37	-8.156	1.44	-.10	.768	10.02	4.16	.00	.00
1C	21.70	.559	19.65	-6.561	1.91	-.86	.744	9.54	3.12	.00	.00
2C	21.90	.561	20.04	-7.194	1.69	-.53	.755	9.81	3.51	.00	.00
3C	21.80	.560	20.00	-7.347	1.65	-.53	.760	9.81	3.25	.00	.00
4C	21.70	.561	19.98	-7.758	1.54	-.14	.759	9.77	3.64	.00	.00
5C	22.00	.549	18.72	-4.563	3.16	-2.04	.668	8.53	1.56	.00	.00
6C	22.00	.560	20.21	-7.477	1.61	-.41	.760	9.91	3.38	.00	.00
7C	21.90	.556	19.69	-6.238	2.03	-.90	.732	9.43	3.12	.00	.00
8C	21.70	.555	19.52	-6.142	2.02	-.95	.734	9.34	2.60	.00	.00
9C	22.20	.555	19.94	-6.248	2.02	-.71	.727	9.48	2.73	.00	.00
10C	22.30	.540	18.56	-4.247	3.47	-1.86	.637	8.11	1.04	.00	.00
11C	18.90	.524	17.12	-6.722	1.75	-.62	.738	7.73	.65	.00	.00
1S.*	11.40	.501	8.55	-3.724	4.68	-1.93	.522	3.15	.91	.00	.00
2S	21.40	.549	18.48	-4.769	2.96	-2.44	.693	8.62	1.95	.00	.00
3S.*	14.40	.519	11.35	-3.900	4.20	-2.49	.573	4.53	.91	.00	.00
4S	22.00	.557	19.74	-6.004	2.14	-1.38	.737	9.55	3.38	.00	.00
5S	21.90	.551	19.38	-5.541	2.37	-1.49	.717	9.15	2.34	.00	.00
6S	22.00	.549	19.43	-5.583	2.34	-1.03	.706	9.01	2.34	.00	.00
1T	21.60	.553	19.17	-5.669	2.31	-1.36	.719	9.08	2.34	.00	.00
2T	21.60	.553	18.80	-5.070	2.71	-1.73	.695	8.78	1.95	.00	.00
3T	21.90	.556	19.78	-6.507	1.92	-.64	.735	9.46	3.00	.00	.00
4T	19.00	.526	16.97	-6.144	1.99	-.60	.714	7.55	.52	.00	.00
5T	18.80	.525	17.00	-6.664	1.78	-.55	.734	7.66	.52	.00	.00
6T	19.70	.522	17.64	-6.248	1.92	-.54	.718	7.81	.65	.00	.00
7T	22.30	.560	20.34	-7.063	1.73	-.35	.746	9.85	3.64	.00	.00
AVERAGES: 90830 BASELINE W133 00 000											
	22.10	.561	20.40	-7.927	1.50	-.14	.764	10.00	4.03	.00	.00
STD	.07	.000	.05	.333	.08	.11	.005	.05	.30	*	*
90830 W182CR007 (4.5E14)											
	21.38	.549	19.10	-6.175	2.14	-.99	.724	9.00	2.33	.00	.00
STD	1.10	.013	1.04	.924	.51	.60	.030	.77	1.06	*	*
PERCENT OF BASELINE											
	96.7	98.0	93.6	122.1	143	*****	94.8	90.0	57.8	*****	*****
STD%	5.3	2.4	5.3	15.4	43	*****	4.6	8.1	32.6	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90831 W183NB002 (2E12) W133 00 000

\*SOL14 1 /10/80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.561	19.82	-6.584	1.90	-.70	.739	9.61	.00	.00	.00
1B	21.90	.555	19.93	-7.008	1.73	-.26	.741	9.52	3.64	.00	.00
2B	21.70	.556	19.84	-7.323	1.64	-.13	.746	9.52	3.64	.00	.00
3B	21.90	.556	20.12	-7.714	1.53	.13	.749	9.65	4.16	.00	.00
4B*	21.60	.551	19.04	-5.437	2.44	-1.46	.709	8.93	2.73	.00	.00
5B.*	21.50	.552	19.17	-5.892	2.18	-1.05	.721	9.04	3.38	.00	.00
1C	19.30	.534	17.35	-6.488	1.87	-.28	.720	7.84	.91	.00	.00
2C	19.30	.531	17.34	-6.462	1.87	-.28	.719	7.79	.78	.00	.00
3C	19.50	.530	17.33	-5.917	2.10	-.80	.710	7.76	.65	.00	.00
4C	19.50	.522	16.51	-4.618	3.00	-1.66	.654	7.04	.46	.00	.00
5C	19.00	.529	16.97	-6.377	1.90	.15	.703	7.47	.65	.00	.00
6C	19.70	.531	17.36	-5.624	2.26	-.90	.699	7.73	.65	.00	.00
7C	19.60	.528	17.14	-5.327	2.44	-1.32	.694	7.60	5.46	.00	.00
8C	19.60	.534	17.52	-6.588	1.83	.77	.693	7.67	.70	.00	.00
9C	19.30	.531	17.34	-6.363	1.91	-.60	.724	7.85	.60	.00	.00
10C	19.80	.531	17.50	-5.719	2.21	-.82	.702	7.80	.65	.00	.00
1S	19.80	.532	17.72	-6.258	1.95	-.42	.715	7.97	.65	.00	.00
2S	19.90	.535	17.88	-6.384	1.91	-.53	.724	8.15	.78	.00	.00
3S	20.30	.535	18.10	-6.319	1.93	.26	.698	8.02	.78	.00	.00
4S	19.80	.536	17.86	-6.584	1.83	-.41	.728	8.17	.78	.00	.00
5S	19.70	.534	17.64	-6.202	1.98	-.69	.720	8.02	.78	.00	.00
1T	19.00	.529	16.88	-5.894	2.12	-.90	.711	7.56	.60	.00	.00
2T	18.80	.524	16.61	-5.760	2.17	-.73	.699	7.29	.52	.00	.00
3T	19.10	.525	16.65	-5.331	2.43	-1.01	.684	7.26	.52	.00	.00
4T	19.20	.529	17.27	-6.488	1.85	-.36	.722	7.76	.60	.00	.00
5T	19.10	.526	16.90	-5.837	2.13	-.58	.699	7.43	1.43	.00	.00
6T	18.90	.523	16.69	-5.653	2.22	-1.11	.705	7.37	1.55	.00	.00
AVERAGES, 90831 BASELINE W133 00 000											
	21.83	.556	19.97	-7.348	1.64	-.09	.745	9.56	3.81	.00	.00
STD	.09	.000	.12	.289	.08	.16	.004	.06	.25	*	*
90831 W183NB002 (2E12)											
	19.44	.530	17.27	-6.009	2.09	-.58	.706	7.69	.98	.00	.00
STD	.38	.004	.44	.500	.27	.53	.017	.30	1.04	*	*
PERCENT OF BASELINE											
	89.0	95.4	86.5	118.2	128	*****	94.7	80.4	25.6	*****	*****
STDZ	2.1	.8	2.7	10.3	24	*****	2.7	3.6	30.6	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

\*SOL15 1 /10/80

90904 W184P001 (6.5E15) W133 00 000

\*SOL15 1 /10/80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.561	19.93	-6.943	1.77	-.44	.744	9.67	.00	.00	.00
1B	22.00	.558	20.28	-7.924	1.49	.06	.757	9.83	4.42	.00	.00
2B*	21.60	.547	18.56	-4.807	2.91	-1.69	.676	8.44	1.95	.00	.00
3B*	21.70	.544	18.63	-4.865	2.84	-1.29	.669	8.35	1.82	.00	.00
4B	21.70	.555	19.95	-7.655	1.55	-.12	.756	9.62	4.16	.00	.00
5B	21.60	.556	20.14	-8.989	1.27	.26	.775	9.84	4.42	.00	.00
1C	20.70	.548	18.92	-7.217	1.65	-.38	.750	9.00	2.47	.00	.00
2C	20.90	.544	18.89	-6.505	1.88	-.80	.738	8.88	1.95	.00	.00
3C	18.80	.526	17.17	-7.225	1.60	-.38	.748	7.83	.78	.00	.00
4C	20.50	.537	18.39	-6.369	1.92	-.27	.716	8.34	1.43	.00	.00
5C	19.70	.529	17.92	-7.042	1.66	-.24	.739	8.14	.91	.00	.00
6C	19.80	.528	18.07	-7.173	1.61	-.30	.745	8.24	.91	.00	.00
7C	21.00	.544	19.46	-8.449	1.34	.31	.761	9.20	2.08	.00	.00
8C	21.20	.548	19.77	-9.098	1.23	.45	.770	9.46	2.73	.00	.00
9C	20.50	.538	18.77	-7.391	1.58	-.18	.749	8.74	1.69	.00	.00
10C	20.80	.544	18.97	-7.162	1.66	-.18	.742	8.88	2.34	.00	.00
1S	21.70	.556	19.86	-7.199	1.68	-.55	.756	9.65	3.38	.00	.00
2S	21.60	.558	19.96	-7.951	1.48	-.27	.768	9.79	3.90	.00	.00
3S	21.50	.553	19.76	-7.523	1.58	-.41	.761	9.57	3.25	.00	.00
4S	20.90	.540	18.50	-5.534	2.34	-1.62	.718	8.57	1.82	.00	.00
5S	21.10	.547	19.01	-6.218	2.01	-1.27	.742	9.05	2.60	.00	.00
6S	21.40	.551	19.45	-6.833	1.78	-.57	.744	9.28	3.12	.00	.00
1T	19.10	.528	17.26	-6.547	1.83	-.81	.737	7.86	.65	.00	.00
2T	18.90	.526	16.87	-5.940	2.08	-1.33	.726	7.63	.60	.00	.00
3T	19.50	.525	17.42	-6.029	2.03	-1.02	.723	7.82	.60	.00	.00
4T	19.00	.525	17.17	-6.624	1.79	-.61	.734	7.75	.59	.00	.00
5T	19.30	.525	17.34	-6.328	1.90	-.74	.727	7.79	.65	.00	.00
6T	19.00	.523	17.10	-6.384	1.87	-.80	.731	7.68	.60	.00	.00
AVERAGES: 90904 BASELINE W133 00 000											
	21.77	.556	20.13	-8.189	1.43	.07	.762	9.76	4.33	.00	.00
STD	.17	.001	.14	.576	.12	.16	.009	.10	.12	*	*
90904 W184P001 (6.5E15)											
	20.31	.538	18.46	-6.943	1.75	-.54	.742	8.60	1.78	.00	.00
STD	.97	.011	1.01	.815	.25	.48	.015	.70	1.05	*	*
PERCENT OF BASELINE											
	93.3	96.8	91.7	115.2	122	*****	97.3	88.1	41.0	*****	*****
STD%	5.2	2.3	5.7	16.6	29	*****	3.1	8.2	26.1	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90906 W185CU-T1004 (1.2E15-1.5E14) W133 00 000  
 \*SOL15 1 /10/80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.559	19.80	-6.511	1.92	-.77	.739	9.57	.00	.00	.00
1B	21.70	.554	19.99	-7.770	1.52	-.17	.760	9.67	3.64	.00	.00
2B*	21.80	.550	19.37	-5.713	2.27	-1.25	.719	9.11	3.00	.00	.00
3B*	21.80	.547	19.29	-5.559	2.34	-1.40	.715	9.02	2.34	.00	.00
4B	21.80	.551	19.82	-6.889	1.76	-.41	.741	9.42	3.12	.00	.00
5B.*	22.20	.550	19.60	-5.511	2.38	-1.26	.709	9.16	3.00	.00	.00
1C.*	22.20	.459	10.18	-5.552	2.11	4.11	.579	3.43	.40	.00	.00
2C	22.10	.457	10.66	-6.101	1.82	.29	.680	3.98	.52	.00	.00
3C	22.40	.459	10.94	-6.163	1.80	.31	.683	4.11	.60	.00	.00
4C	12.30	.458	10.80	-5.951	1.89	-.05	.681	4.05	.52	.00	.00
5C	12.30	.458	10.89	-6.253	1.76	.22	.689	4.10	.52	.00	.00
6C	12.30	.455	10.76	-5.823	1.94	-.07	.674	3.99	.52	.00	.00
7C	12.30	.461	10.85	-6.085	1.84	-.04	.687	4.12	.52	.00	.00
8C	12.10	.460	10.83	-6.772	1.58	.79	.698	4.11	.52	.00	.00
9C	12.50	.462	11.13	-6.497	1.68	.47	.677	4.24	.52	.00	.00
10C	12.30	.457	10.72	-5.743	1.99	-.08	.677	3.99	.52	.00	.00
1S	12.30	.461	10.86	-6.164	1.81	.21	.685	4.11	.55	.00	.00
1S	12.30	.461	10.86	-6.164	1.81	.21	.685	4.11	.55	.00	.00
3S	12.10	.459	10.78	-6.539	1.66	.55	.694	4.08	.55	.00	.00
4S	12.50	.462	11.05	-6.223	1.79	.43	.684	4.17	.55	.00	.00
5S	12.40	.458	10.84	-5.782	1.97	-.23	.676	4.06	.55	.00	.00
1T	11.60	.455	10.20	-5.981	1.88	-.18	.683	3.81	.55	.00	.00
2T	11.10	.454	9.95	-6.907	1.53	.90	.701	3.73	.55	.00	.00
3T	11.50	.458	10.24	-6.531	1.67	.48	.695	3.87	.55	.00	.00
4T	11.90	.460	10.66	-6.786	1.58	.66	.701	4.06	.55	.00	.00
AVERAGES: 90906 BASELINE W133 00 000											
	21.75	.553	19.90	-7.329	1.64	-.29	.751	9.54	3.38	.00	.00
STD	.05	.002	.09	.441	.12	.12	.009	.12	.26	*	*
90906 W185CU-T1004 (1.2E15-1.5E14)											
	12.13	.459	10.72	-6.248	1.78	.27	.687	4.04	.54	.00	.00
STD	.37	.002	.29	.342	.13	.32	.009	.12	.02	*	*
PERCENT OF BASELINE											
	55.8	83.0	53.9	114.8	109	293.8	91.5	42.3	16.0	*****	*****
STD%	1.8	.6	1.7	10.1	17	199.6	2.3	1.9	1.9	*****	*****



TABLE 16 SOLAR CELL I-V DATA (Cont.)

90907 W186C0003 (5.4E13) W133 00 000

\*SOL15 1 /10/80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.559	19.86	-6.635	1.88	-.81	.745	9.65	.00	.00	.00
1B	21.70	.555	19.76	-7.236	1.66	.24	.731	9.32	3.51	.00	.00
2B	21.90	.555	19.74	-6.640	1.86	-.02	.720	9.25	3.25	.00	.00
3B	21.60	.552	19.72	-7.290	1.64	.05	.739	9.32	3.00	.00	.00
4B	21.90	.556	20.05	-7.415	1.61	-.03	.746	9.60	3.64	.00	.00
1C	22.10	.552	19.29	-5.223	2.58	-1.26	.692	8.93	2.34	.00	.00
2C	23.90	.553	21.76	-7.169	1.67	.18	.732	10.23	3.00	.00	.00
3C*	16.00	.532	13.34	-4.426	3.38	-2.43	.638	5.74	1.43	.00	.00
4C*	13.90	.504	10.29	-3.506	5.08	-2.47	.516	3.82	.91	.00	.00
5C*	14.80	.520	11.96	-4.135	3.76	-2.24	.599	4.87	1.30	.00	.00
6C	21.80	.551	19.40	-5.819	2.21	-1.08	.719	9.13	3.00	.00	.00
7C	22.40	.549	19.82	-5.656	2.29	-.95	.708	9.20	2.34	.00	.00
8C	20.90	.546	18.22	-5.139	2.64	-1.68	.696	8.40	2.34	.00	.00
9C*	16.30	.530	13.70	-4.551	3.20	-2.24	.647	5.91	1.56	.00	.00
10C	22.50	.556	20.63	-7.352	1.63	-.40	.757	10.01	1.56	.00	.00
1S	21.60	.548	19.16	-5.612	2.32	-1.50	.721	9.02	2.73	.00	.00
2S	22.20	.552	19.97	-6.368	1.96	-.53	.726	9.41	3.25	.00	.00
3S	20.90	.551	18.26	-5.119	2.68	-2.04	.705	8.58	2.86	.00	.00
4S	22.10	.555	20.43	-8.043	1.45	-.09	.765	9.93	1.56	.00	.00
5S	22.10	.555	20.22	-7.367	1.62	-.07	.746	9.67	3.51	.00	.00
6S	21.60	.553	19.38	-6.155	2.06	-.91	.728	9.20	3.51	.00	.00
1T*	21.40	.537	17.82	-4.303	3.41	-1.72	.635	7.71	1.04	.00	.00
2T	21.70	.556	19.98	-7.751	1.53	-.15	.759	9.69	3.64	.00	.00
3T	21.90	.555	20.22	-7.982	1.47	-.06	.762	9.80	3.77	.00	.00
4T	21.50	.551	19.26	-6.070	2.09	-1.04	.728	9.13	3.00	.00	.00
5T	21.60	.555	19.95	-7.994	1.46	-.06	.762	9.67	3.64	.00	.00
AVERAGES: 90907 BASELINE W133 00 000											
	21.78	.555	19.82	-7.145	1.69	.06	.734	9.37	3.35	.00	.00
STD	.13	.002	.10	.299	.10	.11	.010	.14	.25	*	*
90907 W186C0003 (5.4E13)											
	21.93	.552	19.74	-6.551	1.98	-.73	.732	9.37	2.88	.00	.00
STD	.67	.003	.85	1.050	.43	.65	.024	.50	.68	*	*
PERCENT OF BASELINE											
	100.7	99.6	99.7	108.3	117	*****	99.7	100.0	85.9	*****	*****
STD%	3.7	.8	5.0	19.3	33	*****	4.6	6.9	28.0	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90910 W187C0004 (2.8E14) W133 00 000

\*SOL15 1 /10/80 AM1: P0=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(TO)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.560	19.79	-6.461	1.95	-.84	.739	9.59	.00	.00	.00
1B	21.90	.558	20.07	-7.352	1.64	-.35	.755	9.75	4.29	.00	.00
2B*	21.30	.54	18.73	-4.789	2.91	-1.72	.676	8.48	1.69	.00	.00
3B	21.50	.553	19.42	-6.485	1.92	-.74	.736	9.26	3.25	.00	.00
4B*	21.60	.549	18.52	-4.644	3.08	-2.37	.682	8.56	2.34	.00	.00
5B	21.80	.555	20.00	-7.458	1.60	-.24	.754	9.64	3.77	.00	.00
1C	21.50	.553	19.31	-6.226	2.03	-.81	.728	9.16	3.25	.00	.00
2C	21.40	.556	19.41	-6.733	1.83	-.60	.741	9.33	3.25	.00	.00
3C	21.40	.555	19.38	-6.670	1.85	-.57	.738	9.27	3.00	.00	.00
4C	21.50	.552	19.09	-5.657	2.31	-1.45	.721	9.05	2.34	.00	.00
5C	21.50	.552	19.44	-6.563	1.88	-.67	.737	9.25	3.11	.00	.00
6C	21.60	.550	19.34	-6.085	2.08	-.88	.725	9.10	2.47	.00	.00
7C	21.70	.555	19.68	-6.741	1.83	-.49	.739	9.41	3.51	.00	.00
8C	21.70	.555	19.80	-7.047	1.72	-.50	.749	9.55	3.64	.00	.00
9C	21.50	.551	19.30	-6.240	2.01	-.72	.726	9.09	3.00	.00	.00
10C	21.60	.550	19.06	-5.464	2.42	-1.48	.712	8.94	2.47	.00	.00
11C	21.50	.551	18.93	-5.428	2.45	-1.37	.706	8.84	2.86	.00	.00
1S	21.90	.556	19.76	-6.387	1.96	-.84	.737	9.48	3.38	.00	.00
2S	21.70	.563	20.14	-8.324	1.41	-.17	.775	10.01	4.42	.00	.00
3S	21.70	.558	19.77	-6.918	1.77	-.67	.751	9.61	3.25	.00	.00
4S	22.30	.557	20.10	-6.425	1.95	-.56	.729	9.58	3.12	.00	.00
5S	21.70	.558	20.14	-3.406	1.38	.02	.770	9.86	4.29	.00	.00
1T	20.20	.554	17.83	-5.527	2.41	-1.49	.711	8.41	2.60	.00	.00
2T	20.30	.552	17.54	-4.827	2.94	-2.48	.693	8.22	2.34	.00	.00

AVERAGES: 90910 BASELINE W133 00 000

21.73 .555 19.83 -7.098 1.72 -.44 .748 9.55 3.77 .00 .00

STD .17 .002 .29 .436 .14 .21 .008 .21 .42 \* \*

90910 W187C0004 (2.8E14)

21.48 .554 19.33 -6.426 2.01 -.88 .733 9.23 3.13 .00 .00

STD .48 .003 .68 .897 .37 .57 .020 .44 .58 \* \*

PERCENT OF BASELINE

98.8 99.8 97.5 109.5 117 2.0 97.9 96.6 83.0 \*\*\*\*\* \*\*\*\*\*

STD% 3.0 1.0 4.9 19.0 33 287.8 3.8 6.8 26.4 \*\*\*\*\* \*\*\*\*\*

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90913 W188W004 (2E11) W133 00 000

\*SOL15 1 /10/80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(IC)	N	R	FF	Eff	...	PCDa	PCDb
2R*	21.90	.560	19.86	-6.664	1.87	-.69	.742	9.63	.00	.00	.00
1B	22.60	.556	20.46	-6.682	1.84	-.38	.734	9.76	3.00	.00	.00
2B	22.20	.553	20.03	-6.442	1.93	-.65	.733	9.52	3.51	.00	.00
3B.*	22.10	.547	19.07	-4.875	2.84	-1.68	.682	8.72	2.34	.00	.00
4B	22.00	.556	20.13	-7.339	1.63	-.15	.747	9.67	3.64	.00	.00
1C	21.50	.551	19.49	-6.684	1.83	-.60	.740	9.27	3.00	.00	.00
2C	21.60	.549	19.53	-6.547	1.88	-.66	.737	9.24	2.47	.00	.00
3C	21.90	.555	20.25	-8.085	1.44	-.09	.766	9.85	3.51	.00	.00
4C	21.50	.550	19.26	-6.091	2.08	-.94	.726	9.08	2.73	.00	.00
5C	22.10	.555	20.39	-8.022	1.46	.14	.757	9.81	3.38	.00	.00
6C	22.00	.551	19.79	-6.328	1.97	-.64	.728	9.33	2.73	.00	.00
7C	21.90	.555	20.22	-7.913	1.48	-.16	.764	9.92	3.38	.00	.00
8C	21.60	.551	19.66	-7.005	1.72	-.28	.741	9.33	2.86	.00	.00
9C	21.90	.547	19.46	-5.799	2.21	-.91	.713	9.03	2.21	.00	.00
10C	21.60	.551	19.53	-6.564	1.88	-.66	.737	9.28	3.00	.00	.00
11C	22.00	.551	19.97	-6.822	1.78	-.36	.738	9.45	3.00	.00	.00
12C	21.70	.552	20.04	-8.012	1.45	-.01	.761	9.65	3.51	.00	.00
13C	21.90	.549	20.07	-7.478	1.58	-.06	.749	9.52	3.38	.00	.00
1S	21.90	.552	19.82	-6.679	1.84	-.39	.733	9.37	2.86	.00	.00
2S	22.10	.549	19.62	-5.811	2.21	-.75	.709	9.09	2.86	.00	.00
3S	21.90	.550	20.14	-7.875	1.48	.30	.747	9.52	3.51	.00	.00
4S	22.10	.552	20.20	-7.219	1.66	-.27	.748	9.65	3.00	.00	.00
5S	22.20	.547	19.43	-5.652	2.29	.18	.672	8.63	2.34	.00	.00
1T	22.20	.552	20.17	-7.168	1.67	.43	.723	9.37	3.00	.00	.00
2T	22.00	.551	20.20	-7.628	1.54	-.01	.751	9.63	3.25	.00	.00
3T	22.30	.550	19.66	-5.601	2.33	-.77	.699	9.07	3.51	.00	.00
4T	22.20	.550	20.23	-7.064	1.70	-.25	.743	9.59	3.12	.00	.00
5T	22.20	.548	19.95	-6.292	1.97	-.63	.727	9.35	2.86	.00	.00
6T	22.20	.550	20.33	-7.491	1.57	.12	.743	9.60	3.51	.00	.00
AVERAGES: 90913 BASELINE W133 00 000											
	22.27	.555	20.21	-6.821	1.80	-.39	.738	9.65	3.38	.00	.00
STD	.25	.001	.19	.379	.12	.20	.007	.10	.28	*	*
90913 W188W004 (2E11)											
	21.94	.551	19.89	-6.910	1.79	-.30	.735	9.40	3.04	.00	.00
STD	.24	.002	.33	.781	.27	.39	.021	.28	.37	*	*
PERCENT OF BASELINE											
	98.5	99.2	98.4	98.7	99	123.0	99.6	97.4	89.9	*****	*****
STDZ	2.2	.6	2.6	17.7	23	190.0	3.8	4.0	19.3	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90914 W189NB003 (3E11) W133 00 000  
 \*SOL15 1 /10/80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(IO)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.558	19.86	-6.734	1.84	-.49	.738	9.54	.00	.00	.00
1B	21.90	.558	20.46	-9.244	1.23	.39	.775	10.02	4.29	.00	.00
2B	21.70	.554	19.75	-6.901	1.77	-.55	.746	9.49	3.38	.00	.00
3B*	21.70	.543	18.36	-4.449	3.26	-2.18	.662	8.24	1.69	.00	.00
4B	21.90	.554	19.83	-6.611	1.87	-.69	.740	9.50	3.64	.00	.00
5B*	22.10	.544	18.85	-4.569	3.12	-2.14	.673	8.55	1.69	.00	.00
1C	20.70	.550	18.88	-7.147	1.68	-.28	.745	8.96	1.56	.00	.00
2C	20.70	.547	18.56	-6.279	1.99	-.54	.721	8.63	1.56	.00	.00
3C	20.90	.547	18.87	-6.566	1.87	-.45	.730	8.82	1.30	.00	.00
4C	20.70	.543	18.31	-5.636	2.29	-1.17	.709	8.43	1.04	.00	.00
5C	21.00	.550	19.22	-7.340	1.62	-.22	.749	9.15	1.69	.00	.00
6C	21.00	.544	18.54	-5.537	2.35	-1.31	.709	8.57	1.30	.00	.00
7C	20.50	.523	17.25	-4.569	3.03	-1.16	.640	7.26	.50	.00	.00
8C	20.90	.548	18.93	-6.756	1.80	-.39	.735	8.90	2.21	.00	.00
9C	20.60	.543	18.44	-6.086	2.06	-.94	.725	8.57	1.17	.00	.00
10C	21.10	.546	19.03	-6.529	1.88	-.41	.727	8.86	1.69	.00	.00
11C	20.70	.544	18.40	-5.823	2.20	-1.03	.715	8.52	1.43	.00	.00
1S	20.90	.551	18.88	-6.646	1.85	-.34	.729	8.88	1.95	.00	.00
2S	20.80	.551	18.78	-6.422	1.94	-.92	.738	8.95	2.21	.00	.00
3S	20.70	.544	18.09	-5.261	2.54	-1.37	.694	8.27	1.17	.00	.00
4S	20.50	.547	18.41	-6.236	2.01	-.87	.729	8.64	1.69	.00	.00
5S	20.70	.549	18.51	-6.060	2.10	-.90	.722	8.68	1.82	.00	.00
1T	20.90	.545	17.99	-4.839	2.88	-1.82	.679	8.18	1.17	.00	.00
2T	20.60	.546	18.45	-6.206	2.02	-.63	.720	8.57	1.30	.00	.00
3T	20.10	.536	16.6	-4.356	3.37	-1.02	.616	7.02	.78	.00	.00
4T	20.70	.547	18.62	-6.351	1.96	-.70	.728	8.72	1.43	.00	.00
5T	20.90	.548	18.90	-6.642	1.84	-.47	.733	8.88	1.43	.00	.00
AVERAGES: 90914 BASELINE W133 00 000											
	21.83	.555	20.02	-7.585	1.52	-.28	.754	9.67	3.77	.00	.00
STD	.09	.002	.32	1.179	.28	.48	.015	.25	.38	*	*
90914 W189NB003 (3E11)											
	20.74	.545	18.46	-6.061	2.16	-.81	.714	8.55	1.45	.00	.00
STD	.22	.006	.59	.773	.44	.41	.032	.51	.41	*	*
PERCENT OF BASELINE											
	95.0	98.2	92.2	120.1	133	-86.9	94.7	88.4	38.4	*****	*****
STD%	1.4	1.4	4.5	24.2	55	884.8	6.2	7.7	15.9	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

90917 W190CU-ZR001 (2E15-1.2E12) W133 CO 000  
 \*SOL15 1 /10/80 AM1: PO=91.60MW/CM^2 NO AP. COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.562	19.83	-6.620	1.89	-.66	.740	9.63	.00	.00	.00
1B	22.30	.559	20.73	-8.711	1.32	.29	.768	10.12	4.55	.00	.00
2B	22.20	.556	20.30	-7.482	1.59	.26	.738	9.64	3.64	.00	.00
3B	22.30	.557	20.57	-7.992	1.47	.17	.755	9.92	3.64	.00	.00
4B.*	22.10	.555	19.69	-5.880	2.19	-.96	.718	9.32	3.25	.00	.00
1C	19.40	.532	17.15	-5.655	2.25	-1.17	.708	7.72	.78	.00	.00
2C	19.90	.535	17.76	-6.218	1.98	-.21	.707	7.96	.91	.00	.00
3C	20.00	.536	17.05	-4.813	2.37	-1.12	.655	7.43	.78	.00	.00
4C	19.70	.533	17.70	-6.343	1.92	-.63	.725	8.05	.78	.00	.00
5C	20.00	.535	18.05	-6.606	1.82	-.39	.728	8.24	.78	.00	.00
6C	19.50	.533	17.71	-6.942	1.70	-.30	.737	8.10	.78	.00	.00
7C	19.50	.531	17.31	-6.284	1.94	-.67	.723	7.84	.84	.00	.00
8C	20.00	.532	17.76	-5.843	2.14	-.91	.711	8.00	.84	.00	.00
9C	20.00	.531	17.63	-5.764	2.18	-.37	.691	7.77	.84	.00	.00
10C	19.90	.533	17.77	-6.070	2.04	-.80	.719	8.06	.84	.00	.00
11C	20.00	.535	17.98	-6.419	1.89	-.46	.723	8.19	.78	.00	.00
1S	19.80	.536	17.77	-6.352	1.93	-.45	.720	8.08	.78	.00	.00
2S	19.70	.535	17.57	-6.298	1.95	.17	.699	7.79	.83	.00	.00
3S	19.50	.534	17.69	-6.884	1.72	-.28	.734	8.09	.91	.00	.00
4S	20.10	.534	18.04	-6.604	1.82	.35	.706	8.01	.91	.00	.00
5S	19.70	.535	17.74	-6.499	1.86	-.43	.725	8.08	.91	.00	.00
6S	19.70	.533	17.67	-6.248	1.96	-.71	.723	8.03	.91	.00	.00
1T.*	19.20	.524	15.56	-3.814	4.17	-3.86	.625	6.65	.52	.00	.00
2T	19.70	.529	16.68	-4.469	3.20	-2.59	.666	7.34	.65	.00	.00
3T.*	19.30	.524	15.39	-3.564	4.72	-4.99	.616	6.59	.45	.00	.00
4T.*	19.70	.529	16.30	-4.057	3.75	-3.40	.646	7.12	.45	.00	.00
5T	19.50	.526	16.33	-4.288	3.41	-2.79	.654	7.09	.45	.00	.00
6T	19.90	.530	16.96	-4.714	2.94	-1.69	.53	7.40	.45	.00	.00

AVERAGES: 90917 BASELINE W133 CO 000

	22.27	.557	20.53	-8.062	1.46	.24	.754	9.39		.00	.00
STD	.05	.001	.18	.504	.11	.05	.012	.20	.43	*	*
	90917 W190CU-ZR001 (2E15-1.2E12)										
	19.77	.533	17.52	-5.966	2.18	-.77	.706	7.86	.79	.00	.00
STD	.23	.002	.45	.770	.49	.78	.026	.31	.13	*	*
PERCENT OF BASELINE											
	88.8	95.6	85.3	126.0	149	*****	93.7	79.5	20.0	*****	*****
STDZ	1.2	.7	2.9	14.8	47	468.3	5.0	4.8	5.8	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

91107 W191CU-TA001 (2E15-6.8E11) W133 00 000  
 SOL16 1 /10/80 AMI: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(10)	N	P	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.562	19.91	-6.771	1.84	-.74	.748	9.73	.00	.00	.00
1B	21.50	.555	19.63	-7.143	1.69	-.36	.748	9.44	3.90	.00	.00
2B	21.90	.556	19.98	-7.196	1.68	-.08	.741	9.54	4.16	.00	.00
4B	22.00	.560	20.50	-8.911	1.29	.27	.773	10.07	4.60	.00	.00
5B	21.50	.550	19.31	-6.288	1.99	-.64	.726	9.07	3.12	.00	.00
1C	21.00	.541	18.44	-5.473	2.38	-.92	.694	8.34	1.30	.00	.00
2C	20.20	.541	18.22	-6.718	1.80	.05	.719	8.31	1.17	.00	.00
3C	20.60	.547	18.43	-6.134	2.05	-.71	.719	8.57	1.56	.00	.00
4C	20.50	.545	18.49	-6.578	1.86	-.35	.727	8.58	1.17	.00	.00
5C	20.50	.541	18.14	-5.744	2.23	-.81	.704	8.26	1.04	.00	.00
6C	20.40	.541	18.19	-6.016	2.09	-.71	.714	8.33	1.04	.00	.00
7C	20.50	.536	17.65	-4.912	2.78	-1.52	.675	7.85	.91	.00	.00
8C	20.40	.541	18.08	-5.804	2.20	-.79	.706	8.24	1.17	.00	.00
9C	20.40	.541	18.40	-6.514	1.87	-.55	.730	8.52	1.43	.00	.00
10C	20.40	.541	18.19	-6.016	2.09	-.71	.714	8.33	1.17	.00	.00
11C	20.70	.541	18.39	-5.888	2.15	-.72	.709	8.40	1.30	.00	.00
1S	20.40	.544	18.09	-5.827	2.20	-.79	.707	8.30	1.30	.00	.00
2S	20.40	.542	18.22	-6.095	2.06	-.64	.715	8.37	1.17	.00	.00
3S	20.30	.539	17.52	-4.959	2.76	-1.58	.679	7.86	1.04	.00	.00
4S	20.50	.543	18.45	-6.470	1.90	-.42	.725	8.53	1.56	.00	.00
5S	20.80	.544	18.55	-6.088	2.06	-.43	.709	8.49	1.30	.00	.00
6S	20.60	.543	18.33	-5.934	2.14	-.73	.711	8.41	1.30	.00	.00
1T	20.40	.544	18.39	-6.592	1.85	-.22	.723	8.49	1.17	.00	.00
2T	20.30	.533	17.39	-4.820	2.85	-1.55	.669	7.65	1.17	.00	.00
3T	20.20	.540	18.07	-6.218	1.99	-.44	.715	8.24	.91	.00	.00
4T	20.50	.540	18.39	-6.407	1.91	-.16	.714	8.36	1.04	.00	.00
5T	20.50	.540	18.27	-6.084	2.05	-.45	.709	8.30	1.04	.00	.00
6T	20.30	.537	17.98	-5.834	2.17	-.62	.703	8.10	.91	.00	.00
AVERAGES: 91107 BASELINE W133 00 000											
	21.73	.555	19.86	-7.384	1.66	-.20	.747	9.53	3.95	.00	.00
STD	.23	.004	.44	.952	.25	.34	.017	.36	.54	*	*
91107 W191CU-TA001 (2E15-6.8E11)											
	20.47	.541	18.19	-5.962	2.15	-.69	.708	8.30	1.18	.00	.00
STD	.18	.003	.30	.512	.29	.40	.015	.23	.18	*	*
PERCENT OF BASELINE											
	94.2	97.4	91.6	119.3	129	*****	94.9	87.1	29.9	*****	*****
STD%	1.8	1.2	3.6	18.2	39	*****	4.3	5.6	9.3	*****	*****

TABLE 16 SOLAR CELL I-V DATA (cont.)

91108 W192AG001 (2.28E15) W133 00 000  
 SOL16 1 /10/80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.561	19.49	-5.640	2.35	-1.78	.731	9.49	.00	.00	.00
1C.*	21.20	.552	18.84	-5.671	2.31	-1.56	.724	8.96	3.90	.00	.00
2C.*	21.70	.558	19.02	-5.207	2.63	-1.86	.707	9.06	4.29	.00	.00
3B.*	21.50	.552	18.83	-5.255	2.57	-1.54	.701	8.80	2.47	.00	.00
4B.*	21.30	.556	18.95	-5.758	2.27	-1.31	.721	9.03	3.38	.00	.00
1C	21.40	.546	19.35	-6.624	1.84	-.48	.734	9.06	3.00	.00	.00
2C	21.10	.545	19.23	-7.040	1.70	-.42	.746	9.07	3.00	.00	.00
3C	21.60	.543	19.40	-6.231	1.99	-.77	.728	9.03	2.86	.00	.00
4C	21.30	.544	19.22	-6.598	1.84	-.31	.727	8.91	3.64	.00	.00
5C	21.30	.543	19.38	-6.982	1.71	-.31	.741	9.06	3.64	.00	.00
6C	21.60	.543	19.90	-7.930	1.45	.15	.750	9.35	3.00	.00	.00
7C	21.50	.547	19.72	-7.484	1.57	-.19	.753	9.36	3.90	.00	.00
8C	21.20	.544	19.26	-6.812	1.77	-.60	.744	9.08	2.86	.00	.00
9C	21.40	.543	19.18	-6.241	1.98	-.48	.719	8.83	3.00	.00	.00
10C	21.30	.546	19.05	-5.966	2.12	-1.22	.729	8.97	3.38	.00	.00
11C	21.00	.544	19.19	-7.168	1.66	-.50	.753	9.09	3.12	.00	.00
1S	21.00	.542	19.01	-6.580	1.95	-.76	.740	8.91	3.00	.00	.00
2S	21.30	.540	18.76	-5.425	2.40	-1.44	.708	8.61	2.34	.00	.00
3S	21.20	.543	18.94	-5.957	2.12	-1.10	.725	8.85	2.86	.00	.00
4S	21.20	.541	18.86	-5.748	2.22	-1.38	.723	8.77	2.70	.00	.00
5S	21.00	.539	18.63	-5.650	2.27	-1.42	.719	8.61	2.73	.00	.00
6S	21.10	.543	18.83	-5.869	2.16	-1.31	.727	8.81	3.12	.00	.00
1T	21.60	.546	18.98	-5.438	2.42	-1.08	.708	8.71	2.86	.00	.00
2T	21.80	.544	19.40	-5.955	2.12	-.56	.709	8.89	3.12	.00	.00
3T	21.40	.547	19.40	-6.764	1.79	-.41	.736	9.12	3.64	.00	.00
4T	21.20	.544	19.23	-6.783	1.78	-.44	.738	9.00	3.12	.00	.00
5T	21.50	.544	19.40	-6.515	1.87	-.54	.732	9.05	3.51	.00	.00
6T	21.40	.544	19.28	-6.451	1.90	-.47	.727	8.95	3.25	.00	.00

AVERAGES: 91108 BASELINE W133 00 000  
 NO BASELINE

91108 W192AG001 (2.08E15)											
	21.32	.544	19.20	-6.444	1.94	-.70	.731	8.96	3.17	.00	.00
STD	.21	.002	.29	.632	.25	.43	.014	.19	.38	*	*

TABLE 16 SOLAR CELL I-V DATA (Cont.)

91109 W193SN001 (4.85E18) W133 00 000  
 SOL16 1 /10/80 AM1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.565	19.88	-6.646	1.89	-.91	.749	9.80	.00	.00	.00
1B.*	21.90	.562	18.89	-5.028	2.79	-.96	.670	8.72	4.55	.00	.00
2B.*	21.90	.553	18.89	-4.820	2.92	-1.99	.686	8.78	2.47	.00	.00
3B	22.00	.559	20.07	-7.075	1.72	-.42	.748	9.73	3.64	.00	.00
4B	21.20	.552	19.22	-6.638	1.86	-.78	.743	9.20	2.08	.00	.00
1C	21.50	.559	19.68	-7.436	1.62	-.00	.745	9.47	3.38	.00	.00
2C	21.50	.559	19.76	-7.611	1.57	-.19	.756	9.61	3.90	.00	.00
3C	21.50	.556	19.37	-6.314	2.00	-.97	.737	9.31	3.38	.00	.00
4C	21.90	.559	20.16	-7.779	1.53	.00	.755	9.78	4.16	.00	.00
5C	22.00	.560	20.04	-6.958	1.76	-.50	.747	9.73	4.16	.00	.00
6C	21.60	.560	19.76	-7.299	1.66	-.27	.750	9.59	2.47	.00	.00
7C	21.70	.560	19.91	-7.416	1.63	-.38	.757	9.73	4.03	.00	.00
8C*	21.70	.553	19.13	-5.486	2.42	-1.30	.708	8.98	3.00	.00	.00
9C	21.60	.556	19.59	-6.720	1.84	-.62	.742	9.42	3.25	.00	.00
10C	21.90	.558	20.07	-7.408	1.62	-.25	.753	9.73	3.77	.00	.00
1S	21.90	.558	19.86	-6.669	1.86	-.71	.743	9.61	4.16	.00	.00
2S	21.60	.556	19.36	-6.103	2.09	-.98	.728	9.25	3.38	.00	.00
3S	22.00	.559	20.31	-8.058	1.46	.15	.757	9.85	4.16	.00	.00
4S	21.90	.555	19.63	-6.125	2.08	-.85	.726	9.33	3.51	.00	.00
5S	21.90	.557	19.90	-6.814	1.80	-.54	.743	9.58	4.03	.00	.00
1T	21.90	.561	19.43	-5.611	2.37	-1.49	.720	9.36	3.00	.00	.00
2T	21.90	.564	20.12	-7.557	1.60	-.28	.758	9.90	4.30	.00	.00
3T	21.90	.560	19.81	-6.560	1.91	-.67	.738	9.57	3.90	.00	.00
4T	21.60	.560	19.58	-6.736	1.84	-.49	.738	9.44	3.90	.00	.00
5T	21.60	.561	19.74	-7.238	1.68	-.24	.747	9.57	4.42	.00	.00
AVERAGES: 91109 BASELINE W133 00 000											
	21.60	.556	19.64	-6.857	1.79	-.60	.746	9.46	2.86	.00	.00
STD	.40	.004	.43	.218	.07	.18	.002	.27	.78	*	*
91109 W193SN001 (4.85E18)											
	21.76	.559	19.79	-6.969	1.79	-.49	.744	9.57	3.75	.00	.00
STD	.18	.002	.26	.629	.22	.39	.011	.18	.49	*	*
PERCENT OF BASELINE											
	100.7	100.6	100.8	98.4	100	119.1	99.8	101.1	131.1	*****	*****
STD%	2.7	1.0	3.6	12.7	17	108.3	1.8	4.8	57.6	*****	*****



TABLE 16 SOLAR CELL I-V DATA (Cont.)

91113 W194T1012 (3.0E12) W133 00 000  
 SOL16 1 /10/80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.564	19.80	-6.361	2.00	-1.27	.749	9.78	.00	.00	.00
1B	22.10	.558	20.30	-7.586	1.57	-.11	.753	9.83	4.16	.00	.00
2B	21.90	.562	20.09	-7.449	1.62	-.25	.754	9.82	3.90	.00	.00
3B	22.00	.563	20.19	-7.477	1.62	-.29	.756	9.90	4.55	.00	.00
4B	21.90	.561	19.95	-7.066	1.73	-.26	.742	9.65	4.03	.00	.00
5B	22.10	.559	20.23	-7.348	1.64	-.17	.749	9.78	3.90	.00	.00
1C	18.60	.547	16.76	-6.564	1.89	-.39	.724	7.79	.78	.00	.00
2C	18.50	.540	16.46	-6.059	2.08	-.54	.707	7.47	.52	.00	.00
3C	18.70	.546	16.96	-6.959	1.74	-.10	.731	7.89	.78	.00	.00
4C	18.80	.544	16.95	-6.609	1.86	-.32	.725	7.84	.65	.00	.00
5C	18.50	.538	16.66	-6.411	1.92	-.91	.733	7.72	.65	.00	.00
6C	18.50	.537	16.37	-5.871	2.17	-.56	.699	7.35	.52	.00	.00
7C	18.80	.546	17.05	-6.939	1.75	-.16	.732	7.95	.70	.00	.00
8C	18.70	.532	16.41	-5.660	2.26	-.35	.683	7.19	.52	.00	.00
1S	18.40	.541	16.45	-6.311	1.97	-.25	.710	7.48	.60	.00	.00
2S	18.80	.544	16.95	-6.609	1.86	-.32	.725	7.84	.78	.00	.00
3S	18.30	.540	16.36	-6.286	1.98	-.31	.711	7.43	.52	.00	.00
4S	18.80	.546	17.08	-7.016	1.72	-.19	.735	7.98	.78	.00	.00
5S	18.60	.546	16.70	-6.439	1.94	-.33	.718	7.71	.65	.00	.00
6S	18.50	.544	16.67	-6.600	1.87	-.29	.723	7.70	.72	.00	.00
1T	18.20	.543	16.08	-5.753	2.26	-.93	.702	7.34	.40	.00	.00
2T	18.00	.542	16.31	-6.958	1.74	-.03	.728	7.51	.55	.00	.00
3T	18.00	.540	16.28	-6.687	1.75	.01	.725	7.45	.52	.00	.00
4T	18.00	.538	16.17	-6.506	1.89	-.23	.717	7.34	.42	.00	.00
5T	18.20	.543	16.43	-6.709	1.83	-.24	.725	7.58	.52	.00	.00
6T	18.40	.543	16.51	-6.360	1.96	-.55	.721	7.61	.65	.00	.00
AVERAGES: 91113 BASELINE W133 00 000											
	22.00	.561	20.15	-7.385	1.64	-.22	.751	9.79	4.11	.00	.00
STD	.09	.002	.12	.177	.05	.07	.005	.08	.24	*	*
91113 W194T1012 (3.0E12)											
	18.47	.542	16.58	-6.475	1.92	-.35	.719	7.61	.61	.00	.00
STD	.27	.004	.29	.391	.16	.24	.013	.22	.12	*	*
PERCENT OF BASELINE											
	83.9	96.7	82.3	112.3	117	37.8	95.7	77.7	14.9	*****	*****
STD%	1.6	1.0	1.9	7.5	14	197.0	2.3	3.0	3.9	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

91128 W195TI-V-M0001 (3E12-3E12-6.0E11) W133 00 000  
 SOL16 1 /10/80 AM1: P0=91.50MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
2R*	21.90	.564	19.81	-6.436	1.97	-1.07	.745	9.74	.00	.00	.00
1B	22.00	.558	20.20	-7.671	1.55	.12	.748	9.71	4.81	.00	.00
2B	21.90	.558	20.23	-8.105	1.45	.15	.758	9.80	4.55	.00	.00
3B	21.80	.553	19.60	-6.318	1.98	-.63	.727	9.27	3.51	.00	.00
4B.*	22.10	.553	19.20	-4.977	2.78	-1.91	.696	8.99	3.12	.00	.00
1C	18.40	.524	16.39	-6.167	1.97	-.25	.704	7.18	.52	.00	.00
2C	18.70	.519	16.53	-5.799	2.13	-.63	.699	7.17	.46	.00	.00
3C	17.10	.510	14.98	-5.671	2.18	-.29	.680	6.27	.39	.00	.00
4C	17.90	.522	16.02	-6.305	1.91	-.47	.716	7.07	.52	.00	.00
5C	18.10	.524	16.34	-6.728	1.76	-.21	.725	7.28	.39	.00	.00
6C	18.50	.523	16.34	-5.901	2.10	-.19	.691	7.07	.52	.00	.00
7C	18.40	.517	15.78	-4.917	2.71	-1.42	.667	6.71	.39	.00	.00
8C	18.40	.521	16.22	-5.806	2.14	-.33	.690	6.99	.52	.00	.00
9C	18.30	.519	16.22	-6.053	2.01	-.08	.695	6.98	.52	.00	.00
10C	18.10	.514	15.89	-5.645	2.20	-.51	.686	6.75	.52	.00	.00
1S	18.60	.528	16.74	-6.516	1.84	-.39	.723	7.51	.52	.00	.00
2S	18.40	.525	16.59	-6.701	1.77	-.03	.720	7.35	.52	.00	.00
3S	18.60	.526	16.73	-6.498	1.84	-.39	.722	7.48	.52	.00	.00
4S	18.80	.529	16.87	-6.371	1.90	-.45	.719	7.56	.52	.00	.00
5S	18.50	.526	16.65	-6.507	1.84	-.42	.724	7.45	.65	.00	.00
1T	18.30	.522	16.07	-5.614	2.25	-.70	.690	6.97	.39	.00	.00
2T	17.50	.519	15.60	-6.327	1.90	.18	.699	6.71	.39	.00	.00
3T	18.10	.520	16.02	-5.942	2.07	-.30	.695	6.92	.39	.00	.00
4T	18.00	.519	16.13	-6.471	1.83	.01	.709	7.01	.40	.00	.00
5T	18.10	.522	16.16	-6.267	1.93	-.24	.708	7.08	.46	.00	.00
6T	18.40	.521	16.32	-5.961	2.06	-.50	.702	7.12	.46	.00	.00
AVERAGES: 91128 BASELINE W133 00 000											
	21.90	.556	20.01	-7.365	1.66	-.12	.745	9.59	4.29	.00	.00
STD	.08	.002	.29	.761	.23	.36	.013	.23	.56	*	*
91128 W195TI-V-M0001 (3E12-3E12-6.0E11)											
	18.25	.521	16.22	-6.103	2.02	-.36	.703	7.08	.47	.00	.00
STD	.39	.004	.42	.430	.21	.32	.016	.30	.07	*	*
PERCENT OF BASELINE											
	83.3	93.7	81.0	117.1	121	*****	94.4	73.8	11.1	*****	*****
STD%	2.1	1.2	3.3	15.0	32	*****	3.8	5.0	3.3	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

91129 W196TI-V-MO-TA001 (3.0E12-3.0E12-6.0E11-3.0E11) W133 00 000  
 SOL16 1 /10/80 AN1: PO=91.60MW/CM^2 NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Erf	OCD	PCDa	PCDb
2R*	21.90	.565	19.85	-6.544	1.93	-.99	.747	9.78	.00	.00	.00
1B	22.50	.555	20.50	-7.142	1.69	-.02	.737	9.74	4.55	.00	.00
2B	22.00	.549	20.17	-7.574	1.55	.12	.745	9.52	3.25	.00	.00
3B*	22.20	.548	19.25	-5.041	2.70	-1.37	.684	8.81	2.47	.00	.00
4B	22.40	.554	20.56	-7.735	1.52	.33	.743	9.75	4.16	.00	.00
5B	22.40	.553	20.32	-6.849	1.78	-.21	.734	9.62	4.03	.00	.00
1C	18.80	.526	16.30	-5.237	2.50	-.92	.675	7.06	.39	.00	.00
2C	18.30	.528	16.45	-6.643	1.80	.20	.711	7.26	2.34	.00	.00
3C	18.60	.528	16.76	-6.732	1.76	.15	.716	7.43	.52	.00	.00
4C	18.30	.525	16.33	-6.246	1.95	-.23	.707	7.20	.46	.00	.00
5C	18.30	.523	16.07	-5.670	2.22	-.46	.686	6.95	.30	.00	.00
6C	18.60	.526	16.60	-6.286	1.93	-.06	.704	7.29	.40	.00	.00
7C	18.70	.526	16.56	-5.953	2.08	-.27	.696	7.24	.50	.00	.00
8C	18.50	.525	16.55	-6.394	1.88	.01	.707	7.26	.40	.00	.00
9C	18.50	.524	16.32	-5.800	2.15	-.45	.693	7.10	.52	.00	.00
10C	19.00	.527	16.96	-6.351	1.90	.16	.701	7.43	.50	.00	.00
1S	18.80	.532	16.76	-6.195	1.99	-.19	.705	7.45	.46	.00	.00
2S	18.70	.532	16.74	-6.429	1.89	.07	.707	7.44	.52	.00	.00
3S	18.60	.530	16.64	-6.377	1.91	-.09	.709	7.39	.52	.00	.00
4S	19.00	.531	17.12	-6.780	1.75	.32	.713	7.61	.52	.00	.00
5S	18.90	.530	17.01	-6.659	1.79	.11	.714	7.57	.52	.00	.00
1T	18.60	.528	16.29	-5.490	2.35	-.92	.690	7.16	.39	.00	.00
2T	18.20	.526	16.27	-6.422	1.88	.14	.704	7.13	.39	.00	.00
3T	18.40	.525	16.42	-6.362	1.90	.18	.701	7.16	.39	.00	.00
4T	18.50	.524	16.38	-6.042	2.03	.08	.690	7.07	.39	.00	.00
5T	18.30	.519	15.78	-5.185	2.51	-.64	.664	6.67	.30	.00	.00
6T	18.70	.527	16.75	-6.531	1.83	.28	.705	7.34	.40	.00	.00

AVERAGES: 91129. BASELINE W133 00 000

	22.33	.553	20.39	-7.325	1.63	.06	.740	9.66	4.00	.00	.00
STD	.19	.002	.15	.350	.10	.20	.004	.09	.47	*	*
	91129 W196TI-V-MO-TA001 (3.0E12-3.0E12-6.0E11-3.0E11)										
	18.59	.527	16.53	-6.180	2.00	-.12	.700	7.25	.53	.00	.00
STD	.23	.003	.31	.455	.22	.36	.013	.21	.41	*	*
PERCENT OF BASELINE											
	83.3	95.3	81.1	115.6	122	*****	94.6	75.1	13.3	*****	*****
STDZ	1.8	.9	2.1	10.5	22	*****	2.3	3.0	13.1	*****	*****

TABLE 16 SOLAR CELL I-V DATA (Cont.)

91130 W197TI-V-MO-TA-CUG01 (3E12-3E12-6E11-3E11-2E15) W133 00 000  
 SOL16 1 /10/80 AM1: PO=91.60MW/CM<sup>2</sup> NO AR COATING

ID	ISC	VOC	IP	LOG(I0)	N	R	FF	Eff	OCD	PCDa	PCDb
>IMPURITY CONCENTRATIONS (4E12-2.8E12-5.3E11-5.1E11-1.3E15)											
2R*	21.90	.562	19.86	-6.639	1.89	-.79	.744	9.69	.00	.00	.00
1B	22.30	.556	20.11	-6.416	1.95	-.66	.732	9.60	3.25	.00	.00
2B	22.30	.560	20.35	-7.110	1.71	-.36	.748	9.87	4.55	.00	.00
3B	22.40	.559	20.32	-6.630	1.87	-.84	.747	9.89	4.42	.00	.00
4B	22.20	.558	20.28	-7.191	1.68	-.26	.747	9.78	3.51	.00	.00
5B	22.30	.558	20.26	-6.817	1.80	-.53	.743	9.78	3.64	.00	.00
1C	18.30	.526	16.43	-6.374	1.89	-.61	.723	7.36	.39	.00	.00
2C	18.70	.525	16.81	-6.321	1.91	-.88	.730	7.57	.50	.00	.00
3C	19.10	.525	17.05	-6.049	2.03	-.90	.719	7.62	.50	.00	.00
4C	18.50	.523	16.50	-6.078	2.01	-.78	.716	7.32	.50	.00	.00
5C	19.20	.524	17.07	-5.883	2.10	-1.02	.715	7.61	.50	.00	.00
6C	19.30	.524	17.04	-5.661	2.22	-.98	.703	7.52	.50	.00	.00
7C	18.80	.524	16.77	-6.013	2.04	-.97	.719	7.49	.50	.00	.00
8C	18.90	.520	16.56	-5.340	2.40	-1.56	.700	7.27	.50	.00	.00
9C	18.90	.513	16.22	-4.935	2.67	-1.31	.667	6.84	.50	.00	.00
10C	19.20	.523	17.04	-5.856	2.11	-.87	.709	7.53	.50	.00	.00
11C	18.80	.522	16.82	-6.145	1.97	-.90	.723	7.50	.50	.00	.00
1S	18.90	.523	16.63	-5.472	2.33	-1.48	.705	7.37	.50	.00	.00
2S	19.30	.526	17.29	-6.150	1.98	-.97	.726	7.80	.52	.00	.00
3S	19.50	.525	17.31	-5.781	2.15	-1.18	.715	7.74	.52	.00	.00
4S	19.20	.524	17.22	-6.226	1.94	-.84	.725	7.72	.50	.00	.00
5S	18.70	.524	16.78	-6.255	1.93	-.86	.726	7.52	.52	.00	.00
1T	19.00	.523	16.22	-4.671	2.96	-2.31	.673	7.08	.41	.00	.00
2T	19.10	.526	17.03	-6.080	2.01	-.63	.712	7.57	.39	.00	.00
3T	18.50	.520	16.25	-5.503	2.30	-1.21	.698	7.10	.39	.00	.00
4T	19.20	.524	17.01	-5.768	2.16	-.98	.708	7.53	.52	.00	.00
5T	19.00	.524	16.92	-5.948	2.07	-.95	.716	7.53	.52	.00	.00
6T	18.90	.523	16.96	-6.360	1.88	-.50	.721	7.53	.52	.00	.00
AVERAGES: 91130 BASELINE W133 00 000											
	22.30	.558	20.27	-6.833	1.81	-.53	.743	9.79	3.87	.00	.00
STD	.06	.001	.09	.290	.10	.21	.006	.10	.52	*	*
91130 W197TI-V-MO-TA-CU001 (3E12-3E12-6E11-3E11-2E15)											
	18.95	.523	16.82	-5.858	2.14	-1.03	.711	7.46	.49	.00	.00
STD	.29	.003	.33	.438	.26	.38	.016	.22	.04	*	*
PERCENT OF BASELINE											
	85.0	93.7	83.0	114.3	119	5.2	95.7	76.2	12.6	*****	*****
STD%	1.5	.7	2.0	10.3	22	175.4	2.8	3.1	3.0	*****	*****