N69-19940
NASA CR-98358

Philco-Ford Corporation
Microelectronics Division
Blue Bell, Pennsylvania 19422

FINAL REPORT
DEVELOPMENT OF GLASS PASSIVATION METHOD FOR SEMICONDUCTOR DEVICES FOR SATURN SYSTEM
28 JUNE 1966 TO 16 AUGUST 1968

Contract No. NAS8-18048
National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Huntsville, Alabama

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FOREWORD

The work reported here was carried out by the Philco-Ford Corporation, Microelectronics Division at its facilities in Lansdale and Blue Bell, Pennsylvania. This report covers the work performed from 28 June 1966 through 16 August 1968 on Contract No. NAS8-18048.

The program was administered by M. Nowakowski of the Quality Laboratory, George C. Marshall Space Flight Center, Huntsville, Alabama. The project bore the Philco-Ford internal number R-518.

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I - INTRODUCTION

1.1 OBJECTIVE

The contract program had as its objective the development of a glass material and technique for the passivation and encapsulation of semiconductor elements and their associated interconnection metalization. The glass material developed through this task provides a more reliable protection for semiconductor elements than is presently available through oxide passivation and hermetically sealed packages.

1.1 APPROACH

To meet the contract objectives, the program was divided into eight tasks:

1. Information Study
2. Materials Study
3. Design Evaluation
4. Manufacturing Study
5. Manufacture of Glass Encapsulated Devices
6. Performance Evaluation of Glass Encapsulated Devices
7. Specification for Encapsulation
8. Procedure for Encapsulation.

1.3 ORGANIZATION OF REPORT

Sections II through VIII present the technical discussion of each of the Tasks in numerical order (Tasks 7 and 8 are discussed in one section). The appendices contain data too detailed for inclusion in the main body of this report.

1.4 SUMMARY

A technique for providing additional encapsulation for semiconductor elements has been developed. In this technique, a glass coating is formed over the surface of an oxide-passivated semiconductor chip by reacting silane with oxygen. This coating provides an additional protective sheath for the semiconductor chip.

The benefits which accrue from such a coating are as follows:

1. Redundant environmental protection -- the glass coating provides a second line of defense over and above the protection provided by the package.
2. Higher manufacturing yield -- chips and scratches incurred in handling the semiconductor elements during dicing, test, and assembly are minimized.
3. Better reliability -- chips and scratches which pass a visual or electrical screening but which may prove to be reliability hazards are eliminated.
4. Multilayer metalization -- the glass can serve as the dielectric layer between various levels of metal interconnect.
5. Reduced surface channeling -- the glass may be used to increase the dielectric thickness between metal overruns and the underlying silicon, thereby reducing the field which induces the channel.
6. Reduced parasitic capacitance -- the glass may be used to increase the dielectric thickness between metal pads or overruns and underlying silicon so as to reduce capacitive coupling.

It is concluded that the defined process is economical, easy to implement, and does offer the advantages cited above.

II - TASK 1 - INFORMATION STUDY

2.1 INTRODUCTION

It was the purpose of this task to determine what methods and materials are presently available for encapsulating semiconductor junction structures in optically-transparent glass.

For a glassy material to be suitable for use as an encapsulant of semiconductor elements, it must be capable of performing the following functions: (1) protecting the semiconductor element from its ambient, and (2) providing the semiconductor element with mechanical and chemical protection. In view of these functional requirements, a suitable encapsulant must have the following properties:

1. In general, the material must be an insulator with a high dielectric strength.
2. If it is to protect the semiconductor element from being affected by its ambient, it must be free of pinholes; it must be dense with respect to preventing transverse ion migration; and it must have a low dielectric constant.
3. If the material is to provide mechanical protection, it must possess some degree of rigidity.
4. It must be inert in that it must produce no deleterious effects when applied to the element, and it must not react with possible ambients.

5. From the reliability view point, the encapsulating material should be stable and should possess no inhomogeneities.

6. Finally, there will be other minor properties affecting the practicality of a material for use as an encapsulant.

2.2 MATERIALS

Materials whose bulk values indicate that they may be considered as encapsulants and which have been deposited as films are the following: Si_3N_4, SiO, SiO_2, $3Al_2O_3 \cdot 2SiO_2$, Al_2O_3, BN, Dy_2O_3 - B_2O_3 - SiO_2, borosilicate glass (Corning Pyrex 7740), calcium aluminasilicate glass (Corning 191 CP), quartz sealing glass (GE GSC-1), antimony silicate glass, and boroaluminosilicate glass. The stoichiometry of the materials in the form of deposited glass films is never certain. Therefore, it must be understood that when chemical formulas are used to identify a film, they merely indicate the approximate atomic ratios.

Table I lists some of these materials, as well as silicon, with values for a number of their pertinent bulk properties. The table is helpful as a rough guide for choosing a material as an encapsulant. It must be taken into consideration that the values of film properties will vary somewhat from bulk value. These values may depend on the method of film formation and on film thickness as well as on stoichiometry. Furthermore, such a property as freedom from pinholes will pertain only to the material in film form.

TABLE I - PROPERTIES OF MATERIALS

Material	Dielectric Constant	Dielectric Strength (V/cm)	Volume Resistivity (Ω-cm)	Index of Refraction (Na_D)	Thermal Coefficient of Expansion ($\times 10^{-7}/°C$)	Density (G/cm^3)	Hardness (Moh's Scale)
Si	11.7	---	---	4.24	42.0	2.42	7
Si_3N_4	5.0	$>5 \times 10^6$	5×10^{14}	2.0	25 - 80	3.44	---
SiO_2	3.8	5×10^6	1×10^{18}	1.465	5.4	2.20	7
SiO	6.0	5×10^5	5×10^6	≈2.0	---	2.15	7
$Al_2O_3 \cdot SiO_2$	6.0	---	---	---	53.0	3.15	7
Al_2O_3	10.0	high	1×10^{18}	1.7	72.0	3.8	9
Borosilicate glass (Corning Pyrex 7740)	4.6	4.8×10^6	1×10^{16}	1.474	32.0	2.23	---

These materials have been deposited as glassy films by the following techniques: Silicon nitride by reactive sputtering, r-f sputtering, vapor plating, and glass discharge vapor deposition; silicon monoxide by coil evaporation; silica by electron beam evaporation, reactive sputtering, r-f sputtering vapor plating, glow discharge vapor deposition, and electron bombardment polymerization-plus-oxidation; alumina-silica by r-f sputtering, electron beam evaporation, and vapor plating; alumina by electron beam evaporation, reactive evaporation, reactive sputtering, r-f sputtering, and vapor plating; boron nitride by r-f sputtering; dysprosium borosilicate glass by coil evaporation; borosilicate glass by coil evaporation, r-f sputtering, vapor plating, and settling; calcium alumino-silicate and quartz sealing glass by r-f sputtering; and antimony silicate glass and boroaluminasilicate glass by vapor plating. Each technique is described in Appendix A.

2.3 ANALYSIS AND RECOMMENDATIONS

From among the glass materials being considered as protective films, two stand out as superior from the standpoint of introducing least mobile charge. One of these is SiO_2 vapor plated by the oxidation of silane. The other is Si_3N_4, which has been used as a dielectric in developmental insulated-gate field effect transistors and has been considered for planar device fabrication.

Taking all considerations into account, it was concluded that the greatest success may be obtained by using the low temperature oxidation of silane process, or one of its modifications.

III - TASK 2 - MATERIALS STUDY

3.1 INTRODUCTION

The purpose of this task was to determine the optimum characteristics of the encapsulating material as follows:

a. Thickness of deposition.

b. Type of glass.

c. Method of application, such as chemical deposition or glass frit.

d. Preparation required prior to application.

e. Compatibility of thermal expansion coefficients of the materials used.

f. Related characteristics of the materials involved.

Any material selected as an encapsulant should be broadly applicable to semiconductor devices ranging from diodes through bipolar integrated circuits and MOS type products. To this end, its deposition must be compatible with a wide range of wafer processing techniques as well as assembly and packaging processes. Thus, in addition to providing a protective encapsulating coating, there should be no deleterious effects on electrical performance.

In view of this requirement, any glasses which would be potentially useful as encapsulants would be those which, in the form of thin deposits, have the following characteristics:

1. Are insulators of high dielectric strength;

2. Are rigid, inert, and stable;

3. Are crystallographically and structurally compact and, as such, not prone to formation of pinholes, to porosity, or to transverse ion migration.

Obviously, not all possible materials for glass encapsulation will possess all these characteristics to a high degree. Instead, a certain amount of "trading-off" of characteristics can be expected.

Certain practical considerations limit the number of potentially useful materials that could be employed as encapsulants. For example, it is economically desirable to apply the glassing material to wafers rather than individual devices to which bonded connections have already been made. However, if the glass is applied to the wafers, it must be delineated and etched to permit connections to be made at some later time. Therefore, the material must be etchable.

Furthermore, if an elevated temperature is necessary for the deposition of the glass film, then that temperature must not be so high as to have an irreversible, deleterious effect upon the wafer. Since Al metalizations are quite often used on Si devices, the upper temperature limit of a wafer containing such devices must be below the Al-Si eutectic temperature, which is 577°C [1].

Finally, the existing technology governing the deposition of a given material by a given process must be so advanced as to permit the deposition of the required thickness within a practical time.

Taking the above considerations into account, we concluded that the greatest success would be obtained by using the low temperature oxidation of silane, or one of its modifications.

3.2 THICKNESS OF DEPOSITION

3.2.1 General Considerations

In determining the optimum thickness for a glass encapsulating layer, consideration of the need for physical and chemical protection alone indicates that the thicker a layer is, the more protection it will provide.

For example, as thickness increases, the surface pinhole density of deposited glasses decreases. Furthermore, the adverse effects of a constant level of porosity and pinholes decrease as the thickness increases.

The method of deposition which was studied in detail can be classified as a molecular deposition technique. In this technique, the sides of specimen details are coated as well as the tops. Other deposition techniques are characterized by the straight-line transfer of material from source to substrate; surface details in this case produce the phenomenon of shadowing. Although the sides of details are coated during a molecular deposition technique, they are probably not coated quite as thickly as the top horizontal surfaces. Since the major topographical features of an integrated circuit are the metalizations, these thin side coatings represent potential short circuits. This potentiality can be avoided if the glass layer is made at least as thick as the metalizations, that is, the glass coating should be at least 10,000 Å thick.

Also, the abrasion resistance of the glass is greater for greater thicknesses. Since this quality is useful in preventing scratches in the soft Al metalizations, here again it is advisable for the glass

layer thickness to be at least as great as the thickness of those metalizations. Scratches in the Al metalizations, even when they do not result in open circuits, produce a high resistance which ultimately can result in failure.

Finally, the dissolution of metalizations due to electrochemical cell action has been observed to occur on integrated circuits when they are exposed to a moist environment. If a glass encapsulating layer is to retard such electrochemical action, then the thicker the glass layer the greater the retardation.

However, in determining the optimum thickness of the glass layer, there are several considerations, in addition to those of physical and chemical protection, that must be taken into account. These are (1) stray capacitances from metalizations to a field plate (when a field plate is used); (2) the precision of delineation of holes in the glass layer; (3) the accuracy of etching contact cuts of a given depth without excessive etching of the underlying metalization; and (4) the stress in the glass film.

3.2.2 Specific Considerations

3.2.2.1 Stray Capacitance

In certain situations it may be desirable to use a field plate (large-geometry conducting film) over the glass encapsulating layer of an integrated circuit. Such a measure can be employed to prevent a lateral electric field from existing at the ambient-dielectric interface. In the absence of a lateral field, lateral surface ion migration will not occur. This is true whether the ambient is a gas in a hermetically sealed package, room air over an unsealed device,

or plastic over a coated substrate containing active devices or circuits. Another application of the field plate is to cause mobile ions having a specific charge, which are found in the glass layer, to migrate toward the plate rather than toward the device. This could be accomplished by the application of a suitable bias to the field plate. This is especially useful if certain ions which produce an undesirable effect, are known to be at the device surface.

However, the stray impedance which exists between the metalizations and a field plate of this nature limits the frequency response of the integrated circuit. The stray impedance has a component due to the resistance of the glass dielectric which will be in parallel with a component due to the capacitance between the metalizations and the field plate. Thus, if Z_s is the stray impedance, then

$$\frac{1}{Z_s} = \frac{1}{R_g} - \frac{1}{jX_{c,g}} \quad ,$$

where R_g is the resistance due to the glass, and $X_{c,g}$ is the capacitive reactance due to it. A complete transient analysis of the problem requires a specific knowledge of the harmonic components of the input signal to the integrated circuit as well as the impedance characteristics of the devices in the circuit. However, a rough approximation based on a very simple model is all that is required at this point. Consider a short length of metalization, ℓ, of width w which has been covered with a glass layer of thickness t_g, as in Figure 1. Assuming that the parallel resistance and capacitance of the dielectric layer arise only from the dielectric within the volume of the metalization and its normal projection on the field plate, then we have :

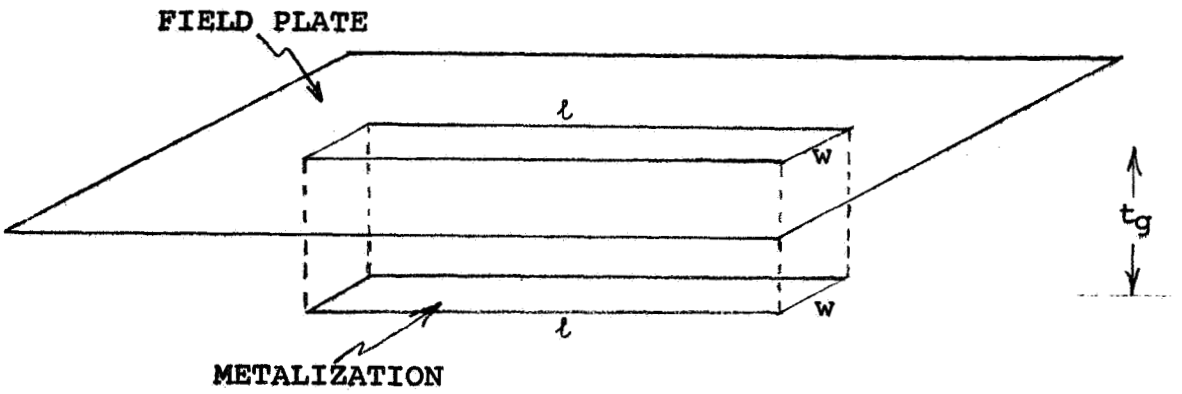

Figure 1. Generalized model for stray capacitance calculation.

$$R_g = \rho_g \frac{t_g}{\ell w} ,$$

where ρ_g is the resistivity of the glass, and

$$X_{c,g} = \frac{1}{\omega C_g} \frac{t_g}{\omega K_g \epsilon_o \ell w} ,$$

where C_g is the "parallel plate" capacitance of the metalization and the field plate, ω is the frequency, K_g is the dielectric constant of the glass, and ϵ_o is the permittivity of free space. Therefore, to prevent serious degradation of the response of the integrated circuit, in general the stray impedance, Z_s, must be as large as possible. By inspection, it is apparent that a high Z_s is obtained when

(a) the design parameters

(1) ℓ and w are as small as possible, and

(2) t_g is as great as possible;

and (b) the material parameters

(1) ρ_g is as great as possible, and

(2) K_g is as small as possible.

3.2.2.2 Delineation

The method by which openings are generated in the glass film for purposes of electrical connection is etching through photoresist masks. An important consideration when etching through masks is that the lateral etch rate is approximately equivalent to the transverse etch rate. Because of this, the thicker a film is relative to the dimensions of the opening, the less faithful the final opening dimensions will be relative to the original mask. However, the degree of fidelity required when cutting through glass passivating layers is not as great

as that required when delineating structures beneath the glass layer. In fact, an error of about 5% is tolerable. This is the situation when the narrowest opening dimension is forty times greater than the glass film thickness. Under these conditions, an opening with a narrowest dimension of 5 mils (125 μ) limits the maximum glass thickness to 3.1 μ. But, if either the etch geometry error or the dimensions of the openings are required to be less than the values that were assumed, then the maximum tolerable glass thickness is correspondingly lower.

3.2.2.3 Etch Depth Accuracy

The etchant which is used to generate the openings in glass layers is selective in that its etch rate for films of glass is relatively greater than its etch rate for evaporated metals of the kind to which contacts must be made. However, in practice, true etchant selectivity is not obtained. There are several reasons for this. When an adherent glass film is deposited on a metalization, a certain amount of solid-state chemical reaction takes place at the glass-metal interface. In fact, such a reaction is necessary for good film adherence. Although the extent of such a reaction is limited in terms of bulk dimensions, it can be significant in terms of film dimensions. Its effect in terms of the problem here is to so modify the etching characteristics of the chemically reacted metal that they tend to become more similar to those of the glass. Since etchants cannot be considered to be absolutely selective, the etching time, t, must be controlled to etch openings in glass films of a given thickness, d. If the rate of etching that has been empirically determined is r, then we have

$$rt = d.$$

If ϵ_r is the fractional error involved in knowing the etch rate of the material (due to point-to-point inhomogeneity across a wafer), and ϵ_d is the fractional error in d due to thickness non-uniformity of the glass film, then there is a fractional error, ϵ_t, induced in the time required for etching,

$$r(1 + \epsilon_r)\ t\ (1 + \epsilon_t) = d(1 + \epsilon_d),$$

or

$$(1 + \epsilon_r)\ (1 + \epsilon_t) = (1 + \epsilon_d).$$

Therefore,

$$\epsilon_t = \frac{\epsilon_d - \epsilon_r}{1 + \epsilon_r} \quad .$$

Since the errors in etch rate and film thickness can be either positive or negative, then the maximum error in time, which is realized when a sample is etched sufficiently long to remove the thicknest and most etch-resistance regions, is

$$\epsilon_t = \frac{|\epsilon_d| - |\epsilon_r|}{1 - |\epsilon_r|} \quad .$$

The absolute error in the etch time, Δt, is

$$\Delta t = \epsilon_t t = \epsilon_t \frac{d}{r} \quad .$$

Thus we see that the absolute error in etching time, ΔT, besides depending on the etch rate error and thickness non-uniformity, also depends on the thickness of the glass layer. The probability of etching the underlying metalization increases with Δt, and therefore with d, the thickness of the glass.

It is difficult to quantitatively correlate considerations such as these with a maximum glass thickness. Therefore, it must suffice to conclude that these considerations limit the maximum practical film thickness, and that, in general, increases in film thickness will adversely affect the etch depth accuracy.

3.2.2.4 Stress

Glass films, as they are deposited, are generally found to be under stress at room temperature. In fact, films in general, whether metal, semiconductor, or dielectric, are rarely, if ever, deposited in a stress-free condition. The stress in glass films, however, limits the thickness to which they can be deposited. Beyond this thickness, the films rupture.

At Philco-Ford, films of SiO_2 have been deposited by means of the silane process onto thin and flexible <111> Si wafers to observe the stress. During deposition, the substrates warped concavely as viewed from the film side, indicating the film was under tension. They remained warped even after they cooled to room temperature. This stress limits the maximum thickness of SiO_2 which can be deposited on a non-deformable Si wafer by this process to between 1.5 and 2.0 μ.

Investigations of the factors associated with stress in films have mainly dealt with metal films formed by vacuum evaporation. These factors, nevertheless, have a great deal of relevance to glass dielectric films produced by either chemical techniques or r-f sputtering. The factors which produce or affect the stress in films are:

1. The thermal coefficients of expansion of the film and the substrate. When a film is deposited at an elevated temperature, differential thermal contraction between film and substrate will produce a stress in the film as it cools to room temperature. This type of stress is reversible.

2. The recrystallization temperature of the film material.[2] When a material such as a metal is evaporated onto a substrate, condensation takes place at a temperature which is generally greater than room temperature. Since the state of thermal expansion of the condensate is characteristic of that temperature, whereas that of the substrate might be much lower, then when the condensate contracts upon cooling it will become stressed. This type of stress is also reversible.

3. Crystalline imperfections, vacancies and dislocations.[3] The crystalline lattice in the vicinity of a vacancy is distorted inwardly toward the vacancy, that is, the vacancy produces a tensile stress in the lattice. Dislocations, on the other hand, cause the lattice to be in a somewhat expanded state. They produce a compressive stress in the lattice. Other imperfections may also produce stresses. These stresses are irreversible in the sense that they can not be annealed out.

4. The angle of incidence of the vapor beam during deposition.[4] This factor pertains to unidirectional deposition techniques such as evaporation.

5. The residual gas composition during deposition.[2]

6. The absorption of gases after evaporation.[5]

7. Surface tension and compression effects.[6] Films that are still in the island stage of development exhibit stress which is partly due to the surface tension of the islands and partly due to the cohesive forces between the islands.

8. Voids and porosity. When voids are occluded in films with a positive surface tension, the net effect is a tensile stress because the lattice is distorted in toward the voids. Porosity can similarly produce stress in films.

9. Lattice mismatch[7]. A factor contributing to the stress in epitaxial heterogeneous overgrowths.

For glass films produced by the silane process, the important factors associated with stress are differences in thermal expansion coefficients, the residual gas concentration during deposition, and voids and porosity in the resultant film. The first factor is important because the silane process requires that the films be formed at elevated temperatures on substrates also at elevated temperatures. The second reason is generally an important one in systems that involve oxygen. When the deposition conditions are modified so as to affect the stoichiometry of the glass film, then any such modification which favors the oxygen content of the film will increase compression of the resultant films and vice versa. The third reason can be expected to be important because the glass films by the silane process are generally less dense than bulk SiO_2.

Recrystallization temperature effects and crystalline imperfections, voids, and dislocations are usually very important factors associated with the stress in films. Although they are usually the most important causes of stress in metal films, they are crystallinity-dependent factors, and, as such, rather insignificant with regard to the stress in glass films.

It may be desirable to change the stress in glass films for several reasons. Obviously, if the upper limit of thickness of a glass film due to stress becomes objectionable, it may be desirable to form glass films with less or, if possible, no stress in them. On the other hand, assuming that a perfect match of coefficients of expansion between film and substrate cannot be obtained, then even a zero initial stress might not be favorable. The best solution is to incorporate an initial compressive stress in the glass film. Depending upon just what the differential expansion between film and substrate is, such a measure can be used to compensate for an anticipated dimensional incompatibility at either elevated temperature storage or operation. The previous comments concerning stress in glass films indicate that the modification of the proportion of reactants is the easiest way to produce a change in the stress of a given film. Changing the void content or the porosity of a film is not as easy. Likewise, to change the thermal coefficient of expansion of a film so as to match the substrate is quite difficult, if not impossible. However, the latter can be accomplished if the film itself is changed. This possibility is discussed in sub section 3.5.

3.3 THE TYPE OF GLASS AND ITS METHOD OF DEPOSITION

Our studies indicated that the objectives of glass encapsulation can be realized with the greatest amount of success if SiO_2 deposited by the silane process is used as the protective glass layer. While this glass technique may not perform every function of a protective layer better than any other material or deposition technique, it is the best method available at the present level of solid-state technology. The selection of the silane process resulted from considering the design requirements and trade-offs of characteristics among the competing techniques for glass encapsulation. On the whole, the silane process provides semiconductor devices with chemical and physical protection from their environment better than any other glassing technique.

The characteristics of SiO_2 deposited by the silane process which led to the above conclusions are:

1. It is completely compatible with all the device processing steps that precede it in time; the temperature required for the deposition process is lower than any critical temperature that is generally characteristic of semiconductor devices.
2. It results in a layer of high resistivity and low dielectric constant with a perfectly adequate dielectric strength.
3. It results in uniform thickness deposits over large areas and has the ability to coat the sides of topographical features as well as the tops.

4. The glass layers have very low pinhole densities.
5. The deposits are sufficiently rigid to provide a high level of mechanical protection to the metalizations.
6. The deposits have etching characteristics that permit the delineation and etching of cuts to the contact pads of underlying metalizations.
7. The glass layers are stable over extremely long periods of time.
8. The layers contain a very low level of contamination.
9. The deposition rates that can be obtained result in very reasonable times for the deposition step.

Other advantages of the silane deposition system are:

1. The technique is already well enough developed to permit its incorporation into a production system.
2. The technique is economical, both in terms of capital equipment required by the deposition system, and the expendable materials that the deposition system consumes.
3. The manipulation of the deposition system requires minimal operator training and can be automated if necessary.

The only drawback to using SiO_2 deposited by the silane process is ion migration. Specifically, a deposited layer of SiO_2 from silane does not inhibit the migration of ions either already in the deposit, or brought to the surface. However, this problem can be solved if phosphosilicate glass is present in the system, as it generally is for bipolar processes. Tests have shown that it acts as an efficient sodium and hydrogen ion getter. In the case where phosphorus is not used in the

basic process, then a thin deposit of phosphosilicate glass can be formed on top of the silane vapor plated glass. The phosphosilicate glass getters the undersirable ions, and minimizes the one weak characteristic that silane deposited SiO_2 shares with glass deposited by other techniques.

3.4 PREPARATION PRIOR TO DEPOSITION

Given a glass film with a linear thermal coefficient of expansion that is perfectly compatible with the substrate, there can still be a problem - that of poor adherence of the film to the substrate. This problem tends to be more critical for thick films that for thin ones, since small stresses in films account for greater forces in thick films than in thin ones. These forces can cause the film to be sheared free of the substrate.

The factors which have been found to affect the adhesion of films to substrates are:

1. The materials of the film-substrate pair,[10]
2. The oxide which forms at the film-substrate interface,[11]
3. The contamination of the substrate,[11]
4. The aging of films which have been deposited on unheated substrates[12] or the deposition of films on substrates at elevated temperatures[11].

The materials in question are deposits of glass and substrates with top surfaces of both thermally grown SiO_2 and a metal - usually Al. This combination of materials does not pose adhesion problems in itself.

Good adhesion between film and substrate is obtained when there is a continuity between the structure of the substrate and the film. This usually occurs via an interfacial oxide. For example, for metals deposited on oxide substrates such as silica or alumina, the greater the tendency of the metal to form an oxide, that is the larger its negative free energy of formation of oxide, the greater is its adhesion to the substrate[11].

From this point of view, glass deposits would be expected to have good adhesion to Al since the free energy of formation of Al_2O_3 is -376.77 kcal./mole, which is high compared to most metals. In reality, Al films on glass are somewhat anomalous[12]. They do not possess the adhesion that a large negative free energy of formation of the oxide suggests. However, Al adhesion to glass is not poor; it is usually found to be greater than the adhesion of metals such as Cu and Cd to glass; and it is always much greater than the adhesion of metals such as Ag and Au. Furthermore, the aging of Al films on glass in air at room temperature dramatically improves their adherence[12]. This suggests that the formation of the oxide layer is not complete at the time of deposition, but in fact continues even during storage at room temperature.

There have been no reports in the literature concerning the adhesion of glass films to oxide substrates. However, on the basis of the free energy of formation of SiO_2 which is -190.9 kcal./mole, adhesion problems resulting from the lack of an interfacial transition region were not expected. This has been borne out by the experience at Philco-Ford. Although no quantitative determinations were made of the adhesion of SiO_2 films formed by the silane process, no indications of poor adherence were encountered in practice.

The substrate temperature during deposition is another factor that influences adhesion. The deposition of a film onto a heated substrate, as opposed to a substrate at room temperature, tends to increase the adhesion of the film[11] if the elevated temperature promotes oxide formation at the film-substrate interface.

The contamination of a substrate surface can degrade the adhesion of a film to that surface. The exact degree of cleanliness or contamination of a surface is difficult to establish. However, films deposited on substrates that are improperly cleaned have poor adherence[11]. Furthermore, severe contamination of a substrate produces major and sometimes total loss of adhesion.

A surface preparation step used to increase the adhesion of a glass coating to thermal SiO_2 is the formation of a phosphosilicate glass top layer by means of phosphorus diffusion. This increases the adhesion of a glass deposit for two reasons. First, the SiO_2-P_2O_5 system forms a eutectic at approximately 15 mole percent P_2O_5 with a eutectic temperature of about 970°C [13]. This is much lower than the melting point of pure SiO_2. Structural continuity between deposit and substrate can be realized by an annealing process as well as by an oxidation process at the interface, and the annealing step is more likely to occur if the liquidus temperature of the components can be decreased. Obviously, a heat treatment facilitates interfacial continuity, whether it results from annealing or oxidation.

The second reason for the adhesion of a glass deposit to be increased by the formation of a phosphosilicate glass top layer is that phosphosilicate glass tends to be hydrophilic. Since moisture lowers the annealing point

of glasses, interfacial continuity can be attained by annealing at a low temperature during deposition or during a separate annealing step. If a phosphosilicate glass layer is used, care must be taken to avoid the presence of excess water at the interface during glass deposition. An excess of water impairs glass adhesion. However, a simple bake insures the most suitable surface moisture level.

Another surface treatment used to increase glass-deposit adhesion is the elevated temperature drive-in of a fluxing agent such as B_2O_3. Again, interfacial continuity is attained by an annealing process. The borosilicate system apparently anneals at about 600°C. The resulting adherence properties are the same as if a borosilicate glass were deposited initially. Such a deposit can be chemically vapor plated by means of the oxidation of silane with triethylboron alkyl.[14]

Our investigations have shown that the optimum thickness range of a glass encapsulating layer of SiO_2 deposited by the oxidation of silane process is 10,000 to 15,000 Å. To minimize leakage and stray capacitance, the resistivity of the layer should be kept as high as possible and its dielectric constant kept as low as possible.

The thermal coefficient of expansion of the glass layer is not a problem. However, the versatility of the silane process permits additional reactants to be admitted to the oxidation chamber. In this way, binary or multi-component glasses of any composition can be deposited. With proper selection, the thermal coefficient of expansion can be tailored, within limits, to a desired value.

Finally, glass encapsulating layers are expected to adhere well. If phosphosilicate glass layers that have been deposited for the purpose of ionic gettering have any effect at all on adhesion, the effect will tend to be one of enhancing the adhesion.

3.5 COMPATIBILITY OF THERMAL COEFFICIENTS OF EXPANSION OF THE MATERIALS USED

When it is necessary to change the thermal coefficient of expansion of a glass film it can be accomplished by introducing a new component to the glass system. In a binary glass system the thermal coefficient of expansion can be obtained at some concentration within the limits of the pure components.

The thermal coefficient of expansion of a polycrystalline material is a structure-insensitive property; that is, it does not depend upon grain size or other structural properties of a material. In binary isomorphous or eutectic systems, the values of such properties do not have extrema beyond the values of the pure component limits. On the other hand, structure sensitive properties, such as hardness, do. The same comments are true for systems that tend to be amorphous. Eitel [8] states that in the case of glasses, since they are "solidified melt solution", that many physical properties of oxide glasses of more than one component can be determined by a summation expression of the type

$$X = a_1Y_1 + a_2Y_2 + a_3Y_3 \quad \ldots\ldots\ldots\ldots\ldots$$

where the Y_1 are the composition fractions of the various components of the glass system, and the a_1 are constants which depend upon the physical property being considered and the particular glass system in question. He also states that the thermal coefficient of expansion is a property that possesses such a dependence upon composition.

Since the literature value of the linear thermal coefficient of expansion of Si is $4.2 \times 10^{-6}/^{o}C$, whereas the value for fused silica is only $0.54 \times 10^{-6}/^{o}C$, it might appear that the two materials have

mismatch problems. However, since the same property for Al_2O_3 is $7.2 \times 10^{-6}/^{o}C$, then it might be possible to form a material of composition $(SiO_2)_x (Al_2O_3)_y$ that has a coefficient of expansion equal to that of Si.

Figure 2 is the equilibrium phase diagram for the binary system SiO_2 - Al_2O_3 [9]. Below about 850°C down to room temperature, the stable crystallographic configurations of SiO_2 are the low and high modifications of quartz. However, it is the vitreous modification of these materials that is relevant to glass encapsulation. The films obtained from the straight-forward silane process have properties analogous to those of fused silica, and from all indications the compound SiO_2-Al_2O_3 films that can be obtained from a modification of that process are also vitreous as determined by glancing angle electron diffraction.

Although thermal coefficient of expansion data is available for fused silica, it is not available for vitreous $3Al_2O_3 \cdot 2SiO_2$ or vitreous Al_2O_3 because these materials have not been obtained in bulk form in the vitreous state. They possess a strong tendency to crystallize from the melt even with rapid cooling.

However, as an approximation, the data that is available for polycrystalline mullite and polycrystalline alumina can be used in the calculation of the thermal coefficient of expansion as a function of composition in the Al_2O_3-SiO_2 system.

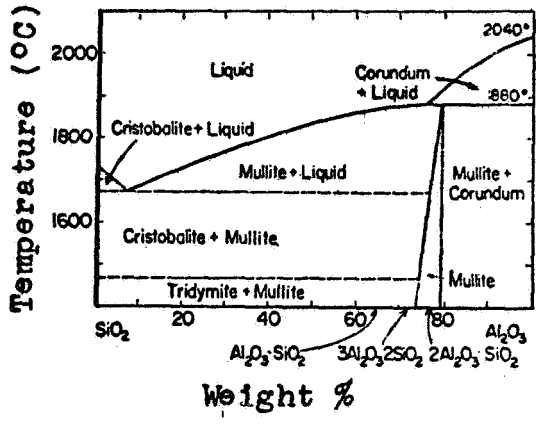

Figure 2. Equilibrium phase diagram for the SiO_2-Al_2O_3 system.[9]

In a binary system with components a and b, the volume thermal coefficient of expansion, γ, is

$$\gamma = v_a\gamma_a + v_b\gamma_b ,$$

where v_i is the volume fraction of component i and γ_i is its volume thermal coefficient of expansion. Using the approximation that the linear thermal coefficient of expansion α is equal to 1/3 the volume coefficient of expansion, we have

$$\alpha = \frac{1}{3}\gamma = \frac{1}{3} v_a\gamma_a + \frac{1}{3} v_b\gamma_b$$

$$= v_a\alpha_a + v_b\alpha_b ,$$

where α_i is the linear thermal coefficient of expansion for component i. Since

$$v_i = \frac{\frac{n_iM_i}{d_i}}{\frac{n_iM_i}{d_i} + \frac{n_jM_j}{d_j}} ,$$

where n_i is the mole fraction of component i, and M_i and d_i are its molecular weight and density, respectively, then one can write

$$\alpha = \frac{\alpha_a(n_aM_a/d_a) + \alpha_b(n_bM_b/d_b)}{(n_aM_a/d_a) + (n_bM_b/d_b)}$$

Using this relationship between the limits SiO_2 and $3Al_2O_3 \cdot 2SiO_2$ for which the linear thermal coefficients of expansion are $0.54 \times 10^{-6}/^oC$ and $5.3 \times 10^{-6}/^oC$, respectively, and then between the limits of

$3Al_2O_3$ and Al_2O_3 for which they are $5.3 \times 10^{-6}/^{o}C$ and $7.2 \times 10^{-6}/^{o}C$, respectively, we obtain the curve in Figure 3. As pointed out, this curve is only valid as an approximation. The thermal coefficients of expansion for glassy $3Al_2O_3 \cdot SiO_2$ and glassy Al_2O_3 may actually be lower than the values that were assumed. Nevertheless, the data has utility as a guide to the tailoring of a material that has a given desired thermal coefficient of expansion.

3.6 RELATED CHARACTERISTICS

The following sub sections discuss some related aspects to this task of material study. The discussions are of a general nature but specific test results are given. A more complete treatment of the material selected is given in the discussion of tasks 7 and 8 - Specification and Procedure for Encapsulation, presented in Section VIII.

3.6.1 Charge Content

The two general classes of charge which influence the surface of the silicon are fixed and mobile. Fixed charge is generally described as that charge which will not move under the influence of high temperature and strong electrical fields. It is of primary importance in determining threshold voltage of MOS devices. Generally, its effect on bipolar devices is less noticeable for the range of surface concentrations normally employed. Mobile charge can also affect MOS devices. It is notorious for changing the threshold voltage as a result of the use or storage of the devices at elevated temperatures. In the case of bipolar devices, mobile charge can accumulate and add to fixed charge. This can result in the inversion of a diffused layer. For instance, a metal stripe crossing the *p*-diffused isolation between

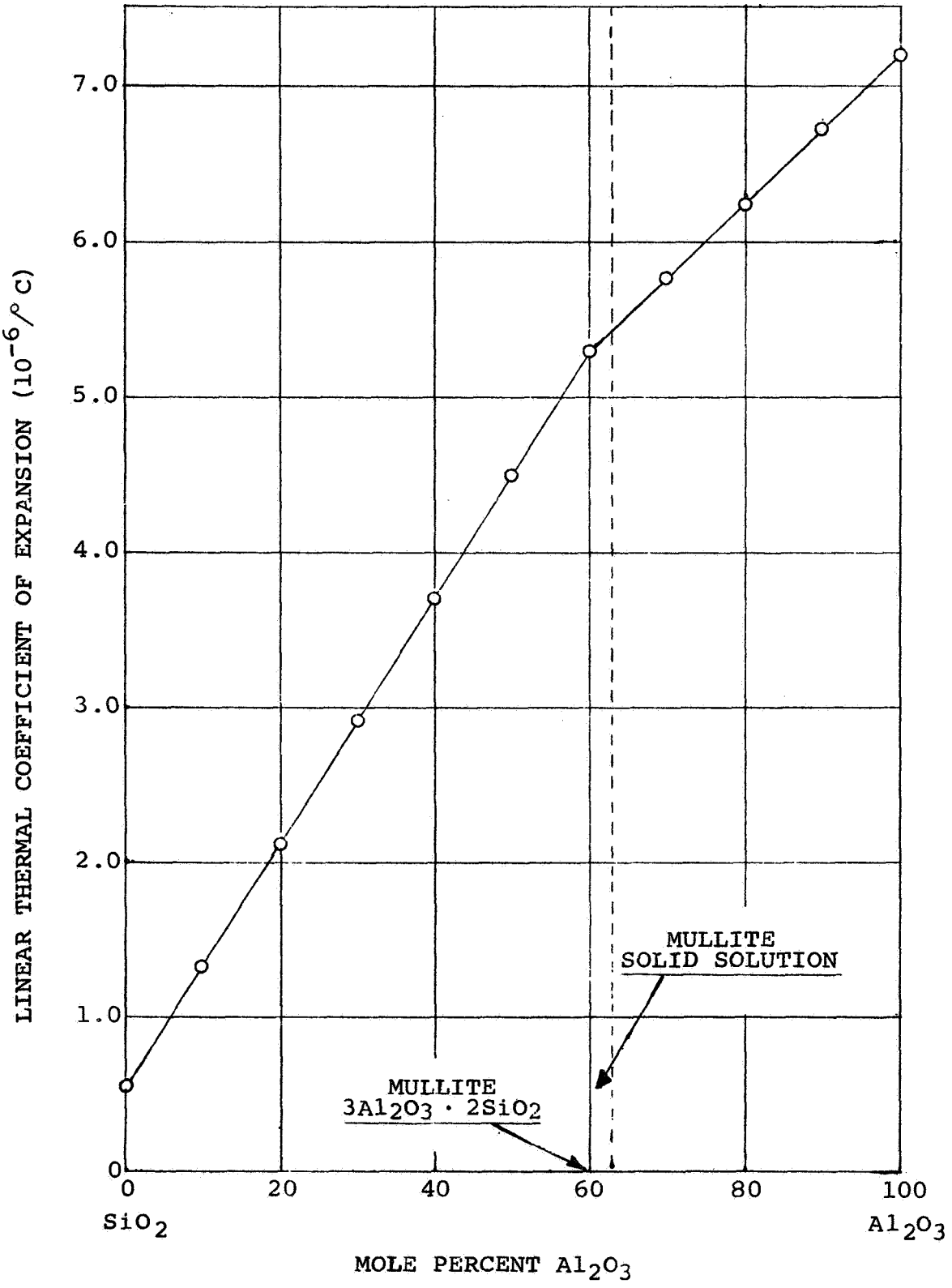

Figure 3. Linear TCE as a function of SiO_2 and Al_2O_3 percentages.

two n regions could cause inversion of the p layer. When this happens, the junction isolation is lost. Since the charge is positive in the oxide, then the additional charge necessary to invert a p-type surface is the mobile charge inherent in the original oxide which will tend to compensate the p-type diffusion. In the case of an n-type surface, the charge is minimal, since the formal negative charge would add to the n-type diffusion.

This discussion further suggests that any additional glass layer should be free of charge, eliminating the possibility of ionized impurities being available at the silicon dioxide and deposited glass interface. As there is further possibility of surface charge on the glass coating influencing the silicon interface, it may be necessary to add a metal field plate over the entire surface, creating an equal potential plane.

Tests were conducted to determine the charge concentration of vapor plated SiO_2 and its effect on thermally grown oxides. The tests and the resulting charge measurements are described in Table II. The following conclusions were made:

1. The vapor plated SiO_2 has a mobile charge concentration equivalent to that of good thermally grown oxide. The process of depositing the glass generates water, which results in increasing the fixed charge of the thermally grown oxide being vapor plated. It has been shown, however, that phosphorus or metalization (aluminum) will successfully mask the moisture. MOS devices with

TABLE II - CHARGE CONCENTRATION OF SiO_2

Wafer No.	Oxide Description	Charge Density (cm^{-2}) Immobile	Mobile Alkali	Mobile RT ions*
286	2100 Å thermally grown oxide (dry O_2)	2.0	1.5	0.7
288	2100 Å thermally grown oxide (dry O_2)	2.2	0.7	0.2
311	Control oxide for wafers 312 and 313, 2000 Å thermally grown oxide <100> Si	0.2	2.9	1.1
284	8000 Å vapor plated oxide on bare silicon	5.0	2.0	0.1
285	8000 Å vapor plated oxide on bare silicon	5.0	2.4	<0.1
282	7000 Å vapor plated oxide on 6000 Å thermally grown oxide	9.0×10^{11}	2.1×10^{11}	0.1×10^{11}
283	7000 Å vapor plated oxide on 6000 Å thermally grown oxide	8.4	2.8	0.1
300	7000 Å vapor plated oxide on 6000 Å thermally grown oxide	9.4	5.6	0.1
301	7000 Å vapor plated oxide on 6000 Å thermally grown oxide	8.1	6.6	<0.1
300A	7000 Å vapor plated oxide on 1250 Å of phosphorus glass on 6000 Å of thermally grown oxide	4.0	0.4	0.2
301A	7000 Å vapor plated oxide on 1250 Å of phosphorus glass on 6000 Å of thermally grown oxide	4.3	0.3	<0.1
313	Same as 311 except that after metallization and etch back it was vapor plated with 6000 Å of SiO_2. This oxide was then opened photolithographically to make electrical contacts, <100> Si	0.1	2.5	1.4

*Ions mobile at room temperature (RT ions).

over-lapping metal gates (*p* MOST) have been successfully coated with vapor deposited SiO_2 and shown to be unchanged from initial characterizations. The same tests conducted on bipolar devices have indicated compatibility. These tests also gave evidence that phosphorus glass is capable of gettering the mobile charge.

3.6.2 Pinhole Studies

Pinhole density is one of the important characteristics of a glass passivation layer. The factors contributing to the pinhole density of a glass layer on an integrated circuit include (1) imperfect wafer cleanliness prior to glass deposition, (2) the inherent pinhole density associated with the deposition technique, (3) the pinholes introduced by the etching step because of resist defects, and (4) problems associated with glass layer deposition over a nonplanar surface.

The pinhole density resulting from defects in the photoresist is strongly dependent upon the photoresist processing. Double processing is one technique we have used to minimize the number of pinholes. In this technique, the wafers are coated with resist, the resist is exposed and developed and the glass is etched halfway through; the resist is then stripped and the process repeated, etching the glass through to the bottom metal. A typical pinhole density for a particular resist process is about 200×10^{-4} pinholes/mil^2. Double processing using this same resist process results in a pinhole density of less than 2×10^{-4} pinholes/mil^2.

To determine the pinhole density to be expected from the vapor plating of SiO_2 on an integrated circuit, tests were conducted by sandwiching the layer of glass between two layers of metal and observing electrical shorts. To determine the inherent pinhole density of the vapor plated glass and also to determine the effect which different step heights have on pinhole density, the following test was conducted.

The initial vehicle metalization patterns were delineated in 5 kÅ, 10 kÅ, and 15 kÅ thick aluminum on oxidized wafers and vapor plated with 5 kÅ, 10 kÅ, and 18 kÅ thick glass layers. Aluminum was then evaporated and the metal pattern for the initial vehicle was delineated. Glass etching was done after the field plate was delineated. Control wafers, showing the pinhole characteristics of the glass itself, were made by plating 5 kÅ, 10 kÅ and 18 kÅ thick glass on 10 kÅ thick undelineated aluminum, appling field plates and etching the glass in the same manner as described above. The wafers were then tested by applying 100 V between the top metal (field plate) and the lower metal. The results are shown in Table III. Note that shorts were detected only on those wafers where the thickness of the lower aluminum is greater than the thickness of the glass coating.

TABLE III

PINHOLE DENSITY AS RELATED TO THICKNESS OF METALIZATION & GLASS

WAFER	ALUMINUM THICKNESS	GLASS THICKNESS (kÅ)	SHORTS	PINHOLE DENSITY ($\times 10^{-4}$ pinholes/mil^2)
A	10kÅ*	5	6	1.4
B	10kÅ*	10	1	0.2
C	10kÅ*	18	0	<0.2
D	5kÅ	5	0	<2.1
E	5kÅ	10	0	<0.9
F	5kÅ	18	0	<1.8
G	10kÅ	5	13	11.0
H	10kÅ	10	0	<2.1
I	10kÅ	18	0	<0.9
J	15kÅ	5	6	17.0
K	15kÅ	10	21	17.0
L	15kÅ	18	0	<0.9

* Control units in which the bottom metal did not have a delineated pattern.

The data in Table III indicate that

1. The inherent pinhole density of the glass, thicker than 5 kÅ, is satisfactory for double layer metalization (Wafers A, B, and C).
2. Glass thinner than the lower aluminum is undesirable (Wafers G, J. and K).
3. The same thickness of glass and lower aluminum is satisfactory (Wafers D, H, and L).
4. Glass thicker than the lower aluminum is satisfactory (Wafers E, F, and I).

3.6.3 Etch Rate

It has already been reported that the etch rate of the vapor plated SiO_2 is approximately 8000 Å per minute. Based on a thickness of 10-15,000 Å, the etch time approximates 1-1/2 minutes. Since the glass is clear, it is difficult to determine exactly when all of the material has been removed from the bonding areas.

Tests have been conducted to determine if the etch rate of the SiO_2 is constant, even near the aluminum surface. If the etch rate were constant, in spite of the known reaction of SiO_2 with aluminum, one could utilize the silicon scribe lines to determine when all of the SiO_2 had been removed. Since the scribe lines are silicon, interference colors are observed until the SiO_2 has completely disappeared. The results of these tests showed that, in fact, the etch rate was constant insofar as it would allow use of this technique to determine when to stop etching. There is still some question as to whether the glass is removed from very small openings (1/4 mil^2) as fast as from the pads, but that does not affect this program, since the bonding pads are typically > 15 mil^2.

At present, a slight over-etch condition is being used to guarantee complete removal.

An auxiliary approach considered was rejection masking. In this technique, the photoresist is placed wherever the deposited material is not wanted. After the coating has been deposited, a solvent causes the photoresist to swell and permits the deposited material to fracture away from the surface. Attempts at penetrating the glass coating, even mechanically, proved unsuccessful. Rejection delineation does not appear advisable.

3.6.4 Metalization Protection

During the manufacturing process, most semiconductor manufacturers incur significant losses due to scratched metalization. The mechanical properties of the vapor plated SiO_2 suggest that it can provide a significant degree of protection which will eliminate much of the scratching now occurring.

Vapor plated SiO_2 offers further protection from moisture and other liquid contaminants. Etching tests have been conducted on glassed wafers in which complete protection has been offered to the aluminum metalization from several standard etchants: 10:1 HCL; 20 parts phosphoric acid, 1 part nitric, 4.5 parts water; and several proprietary acid mixtures.

Although not conducted under this contract, the results of several environmental tests on plastic encapsulated devices have further shown that glass coating gives additional protection to the metalized surface

of conventional microcircuits. Moisture penetrating plastic-encapsulated units normally resulted in the electrochemical etching of aluminum metalization. When protected by glass, the attack can only occur at the point where the glass has been opened to permit bonding at the terminal.

As a demonstration of the protection provided by a glass coating, three types of units were tested:

1. Unglassed (control),
2. Glassed in wafer form,
3. Glassed after assembly (although this is considered impractical as a general technique).

The test consisted of covering each unit with water, and applying voltage between package leads 7 and 10 sufficient to cause 10 μA to flow. The units were then dried and electrical continuity was checked between package leads 7 and 10. Table IV shows the results of this test.

The results of this test indicate that glass does provide additional protection for aluminum. However, without additional protection to avoid moisture condensation, glass encapsulation is not sufficient to prevent ultimate failure.

TABLE IV

RESULTS OF GLASS COATING TESTS

Type of Unit	Period of Voltage Application	Electrical Continuity
Type of Unit		
Unglassed	5 sec	No
Glassed in Wafer Form	5 sec	Yes
	10 sec	Yes
	15 sec	No
Glassed After Assembly	5 sec	Yes
	20 sec	Yes

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IV - TASK 3 - DESIGN EVALUATION

4.1 INTRODUCTION

The purpose of this task was to evaluate the proposed design of glass-encapsulated semiconductor devices, primarily silicon monolithic integrated circuits. This evaluation was to consider reliability of the design, parameter tradeoffs necessary to achieve a degree of reliability that is acceptable for manned space systems, and manufacturing or processing changes that would be necessary of this encapsulation technique is employed.

During the initial phase of this program, a more specific definition of the proposed design took place. While glass encapsulation will provide significantly improved reliability and cost reductions by protecting the metalization interconnect pattern, a more complex protection consideration incurs modification of charge distribution, i.e., the effect of fields on the device characteristics. In order to bring the most sensitivity to this area of study, a high bulk resistivity analog integrated circuit of the bipolar type was selected. By using a standard device, wafers were available from production so that, with the modification of the interconnect pattern, a suitable test vehicle was obtained. The following discussion considers the various field effects. The conclusion points out that while deposited glass can be used to design-in imporved reliability, it is not a panacea for poor wafer processing or circuit design. Unless otherwise specified, the devices used in the tests reported in this sub section were unglassed and unsealed.

4.2 DIRECT INVERSION

One observation made during this program was that surface charge can be applied directly by using a MOS capacitor structure. Consider a parallel plate capacitor as sketched in Figure 4 . The voltage applied an easily be related to the surface charge density using the familiar formulas:

$$C\,[fd] = \frac{Q\,[coul]}{V\,[volts]} \tag{1}$$

$$C\,[fd] = \frac{8.85 \times 10^{-10} kA\,[cm^2]}{d\,[cm]} \tag{2}$$

$$\frac{Q\,[electronic\ charges]}{A\,[cm^2]}\ \frac{1}{V\,[volts]} = \frac{8.85 \times 10^{-10} K}{d\,[cm]\ 1.6 \times 10^{-19}\ \frac{[coul]}{[electric\ charge]}} \tag{3}$$

See Figure 5 for plots of surface charge for two typical oxide thicknesses. Since typical oxide thicknesses over the *p*-type base and *n*-type collector regions are 6000Å and 9000Å , respectively, we obtain for *p*-type:

$$\frac{Q/A}{V} = 3.7 \times 10^{10}\ \frac{\text{electronic charges}}{cm^2}/\text{volt},$$

and for *n*-type:

$$\frac{Q/A}{V} = 2.5 \times 10^{10}\ \frac{\text{electronic charges}}{cm^2}/\text{volt}.$$

These constants may be used to determine the voltage necessary on the plate of an MOS capacitor to invert the silicon "plate." Figure 6 is such a plot.

The next step in the utilization of this concept consisted of fabricating the appropriate capacitors. In principle, this presented no problem, since on integrated circuits the emitter metalization (or expanded contact) always crosses the oxide over the base region, and the base metalization often crosses the oxide over the collector region. By separating the emitter metal conductor from its contact to silicon, a plate is formed,

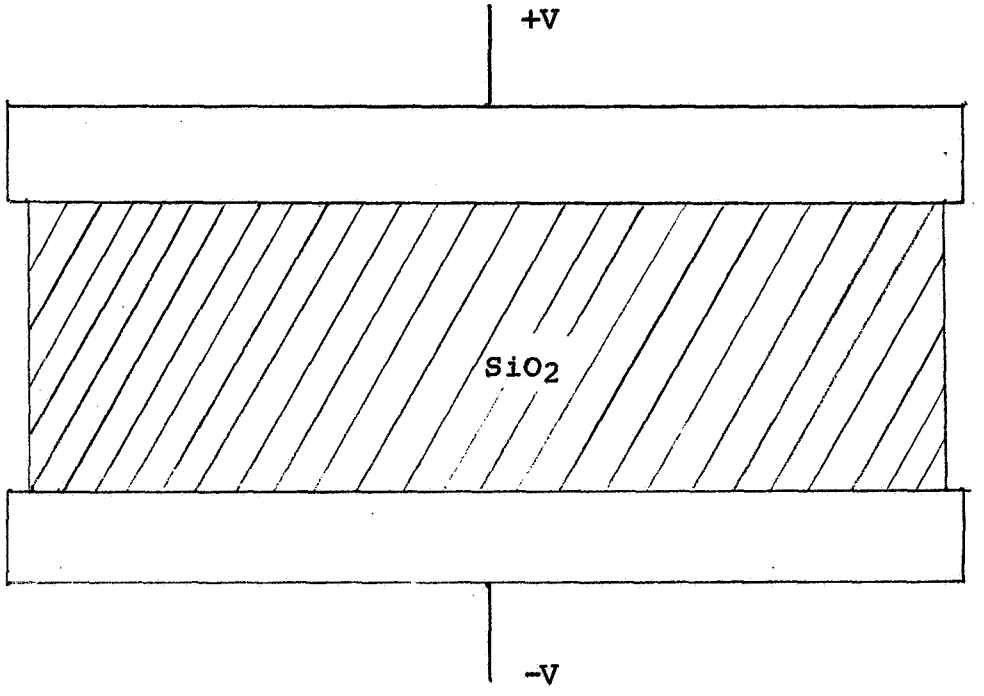

Figure 4. Basic SiO_2 capacitor structure.

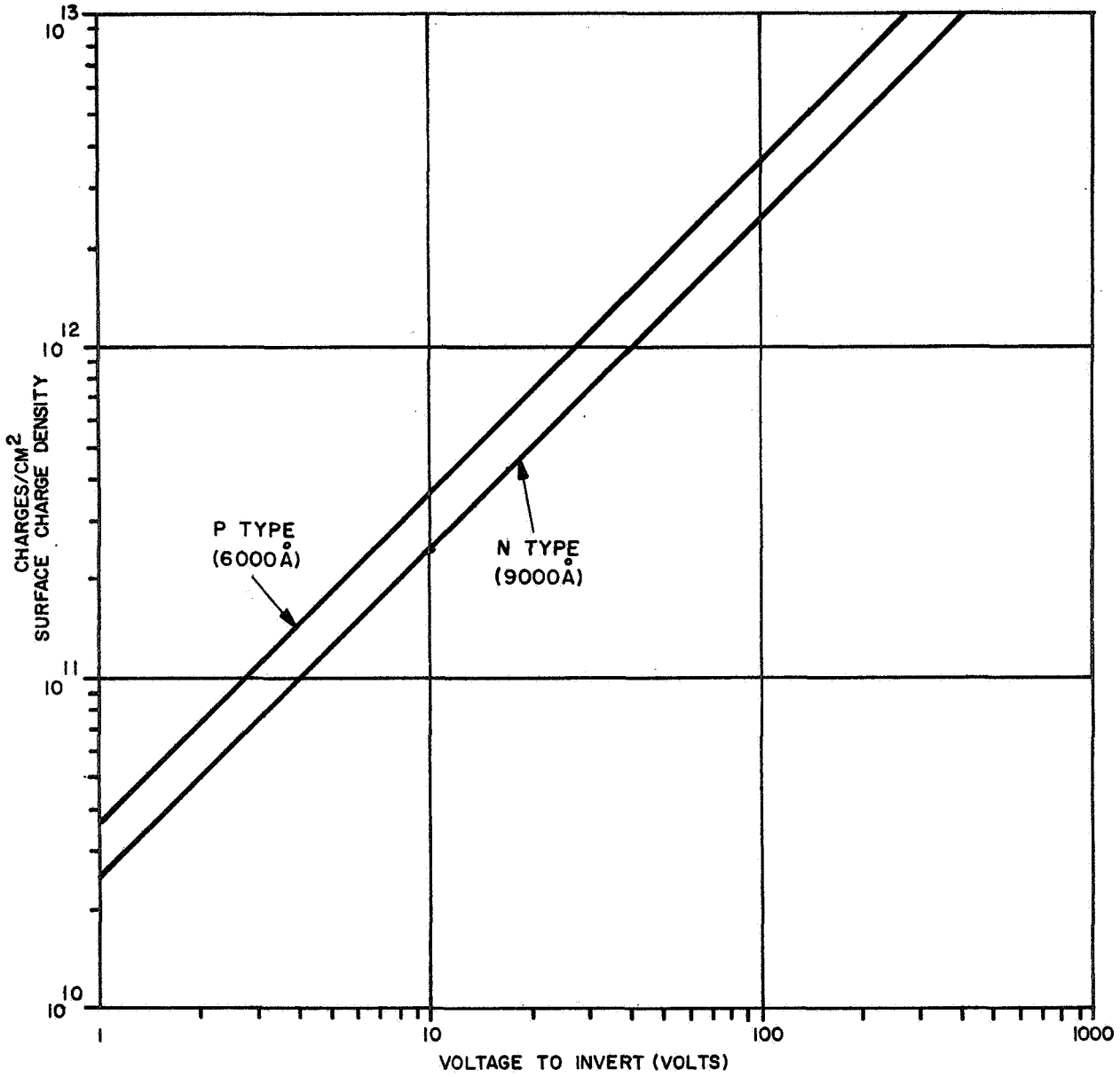

Figure 5. Surface charge as related to the equivalent voltage required for inversion.

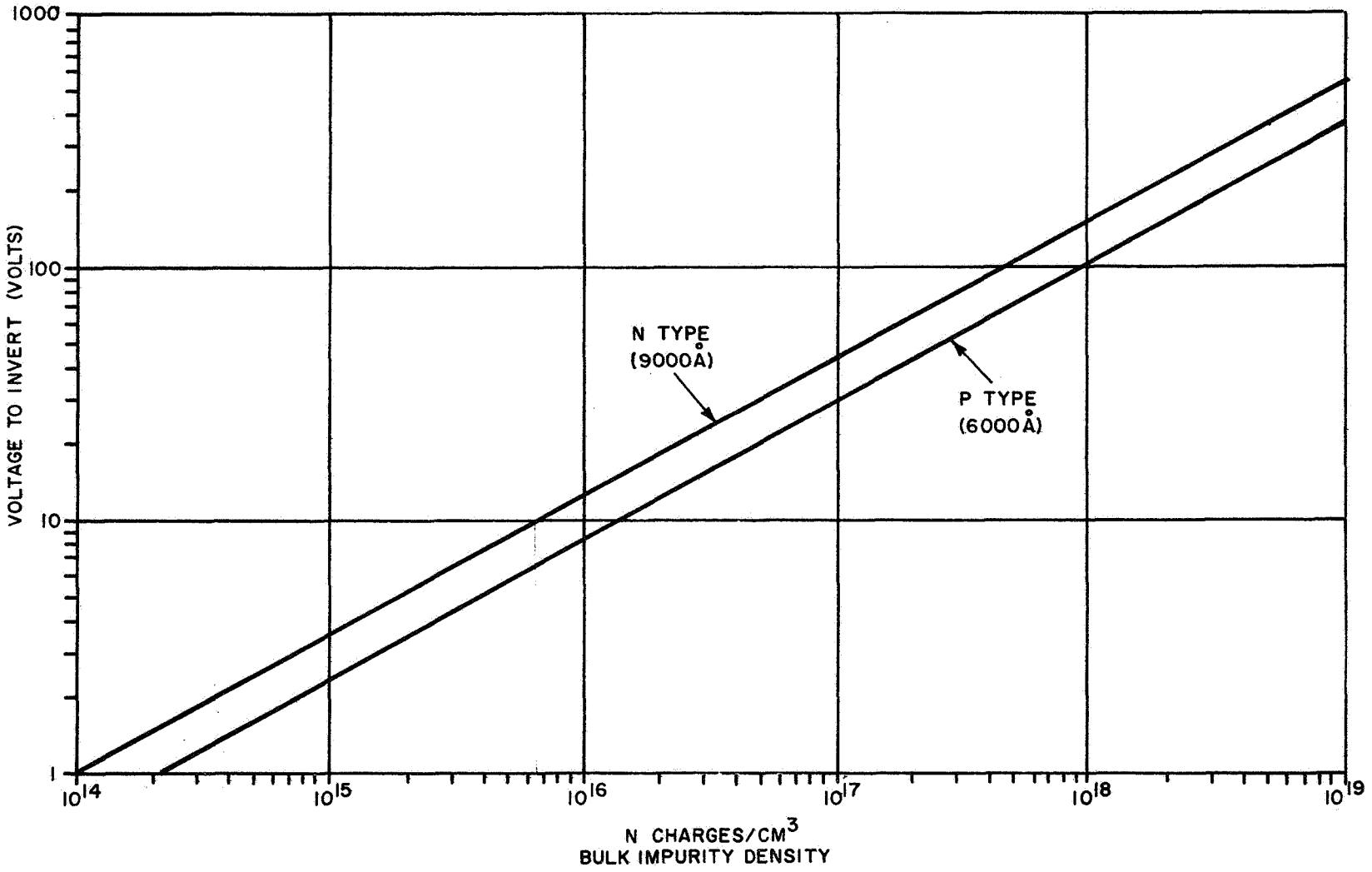

Figure 6. Voltage required to invert a given bulk impurity density.

allowing inversion of part of the base surface. Note that to invert a p-type base, positive bias would be applied to the plate so as the attract electrons to the surface of the p-type silicon. This results in conduction between the n-type collector and emitter.

A tool thus already existed which immediately and predictably allowed quantitative assessment of the amount of surface charge necessary to invert the base surface. Alternatively, by varying the voltage applied to this structure, the effect of surface charge can be correlated to transistor device parameters, the most sensitive of which are expected to be low-current beta, BV_{CBO}, I_{CBO}, I_{EBO} and I_{CEO}. For example, when the base surface has been completely inverted, I_{CEO} increases linearly with increasing voltage on the "gate" or metal over the base region.

The preceding model is useful in assessing the influence of a given amount of surface charge on underlying silicon, but does not permit assessment of the manner in which surface charge may accumulate. A second structure is used to enhance the surface charge separation due to surface fields. Since one of the mechanisms by which an additional layer of glass over a microcircuit will improve device stability is the prevention of surface ion motion in the presence of surface contamination, it is important that this mechanism be studied.

The "classical" degradation mechanism is the existence of surface fringing fields from back biased junctions, as shown in the sketch illustrating surface fringing fields associated with a back biased p-n junction.

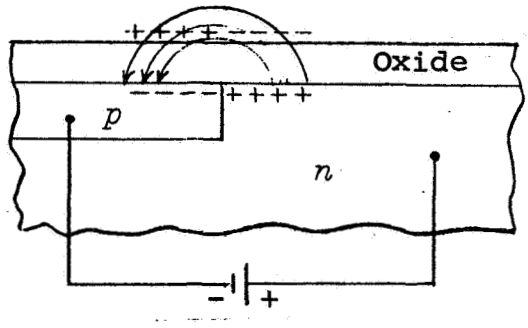

Figure 7. Sketch illustrating surface fringing fields associated with a back biased p-n junction.

The lateral surface field results in charge accumulation which attracts charge to the silicon surface, producing degradation of device performance. Since the tests on back biased junctions failed to produce enough instability on short duration tests to be useful as a study tool, lateral surface fields were set up between conductors on the oxide surface as indicated in sketch illustrating lateral surface fields setup.

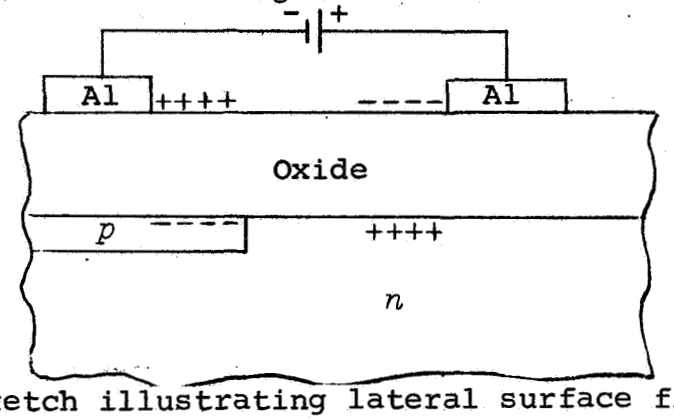

Figure 8. Sketch illustrating lateral surface fields setup.

The fields set up with this structure could be much higher than obtained with fringing fields (limited by diode breakdown), thus resulting in acceleration of charge accumulation. Note in this case that to invert a p region, <u>negative</u> bias is applied to the plate in contrast to positive bias for the capacitively induced charge. This condition of surface fields set up between metal conductors is a situation present on all microcircuits.

A quantitative theoretical treatment of the structure sketched above is impractical because of the variation in surface conditions. The amount of charge accumulated per unit field impressed will be a function of surface conductivity, oxide contamination, time, temperature, etc. The usefulness of the structure depends on the ability to obtain high lateral surface fields. This in turn allows rapid accumulation of surface charge. Since the accumulation of surface charge depends on the surface condition and the ambient to which it is exposed, devices whose surface (that on which the metal interconnects are formed) is protected by an additional glass layer will respond differently than devices with unprotected surfaces.

This structure has several disadvantages which should not be minimized. It should be noted that in addition to performing the desired function of attracting surface charge, a surface plate can itself induce (through a capacitive effect) charge to the surface of the silicon. With the polarity shown, these will be accumulation layers rather than inversion layers, but the extent to which the accumulation layer compensates the inversion is difficult to determine. Obviously, care must be used in placing the surface plates on the device so as to minimize capacitive inversion.

Another, even less well understood, undesirable mechanism is the collection of surface charge by a surface plate. Even if the plate does not collect surface ions it may neutralize them. If the charge is attracted too strongly, it will travel beneath, or on top of, the surface plate and no longer be effective in causing inversion.

A parasitic mechanism common to both capacitive and surface-field-induced inversion is the possibility of the altered effective doping concentration changing the leakage of the back biased junction (for I_{CEO}, the collector-base) before true inversion of the base surface occurs. The effect of this mechanism can be eliminated by an experimental technique, as described below. The point is that for high voltages on the surface, an increase in I_{CEO} may not be an indication of base inversion.

Despite its disadvantages, the surface plate structure has proven to be useful in the study of surface-charge-induced inversion. The presence of these unknowns simply complicates the understanding and interpretation of experimental results. Generally speaking, stray capacitive effects are eliminated by shorting all metal leads together. Since surface charge motion is relatively slow in dry ambients, the surface-charge-induced effects will remain. Application of moisture will drastically alter the surface effects but has little influence on capacitive effects.

Several devices were constructed to facilitate the study of direct inversion. A field was applied between the Si material and a metal plate on the SiO_2. The devices consisted of standard, metalized integrated circuits upon which the metalization was mechanically isolated from the underlying silicon in predetermined locations. The isolated metalization extended across the region being investigated over the adjacent oppositely-doped regions. Figure 9 is a photomicrograph of one of the intial structures used to study inversion.

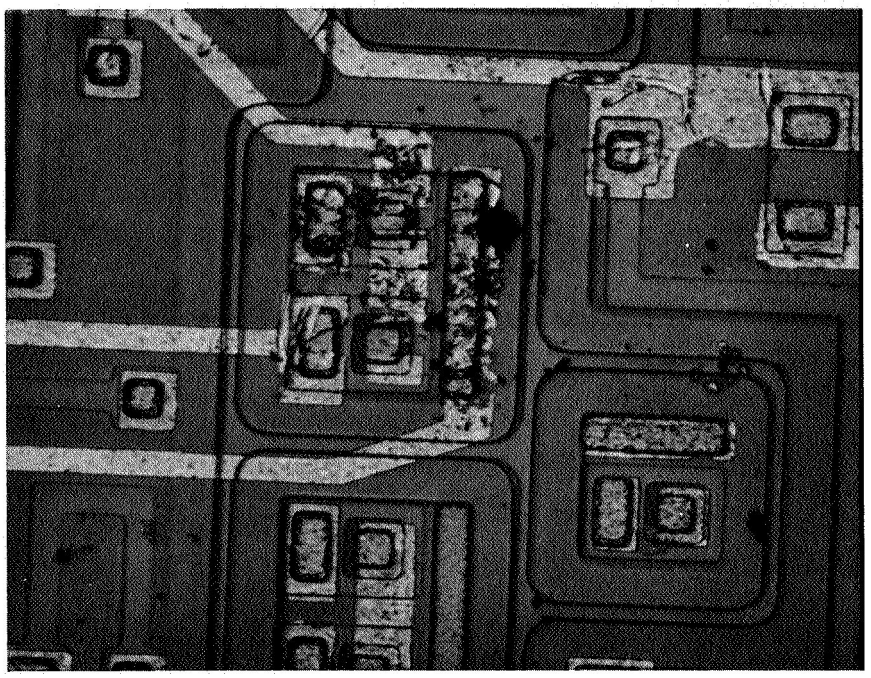

Figure 9. Modified metal pattern to study inversion of a base region.

Inversion of a specific region could be created by applying a voltage of the correct polarity (+ for p, - for n) to the isolated metal with respect to the underlying silicon. The degree of inversion can be directly related to the conductivity between the two regions separated by the region being inverted, much in the manner as an MOS transistor. The conductivity was determined by measuring the current at a constant applied voltage. On a bipolar transistor whose base is being inverted, this parameter is essentially I_{CEO}.

Tests were initiated to characterize the surface charge density necessary to cause inversion of the various resistivity regions present in a microcircuit. The initial test consisted of modifying an integrated circuit transistor so that metalization over the base was isolated as shown in Figure 9 . In MOS terminology the source, gate, and drain were the emitter, isolated metal, and collector, respectively. A voltage of up to 300 V was applied between the isolated metal and the base region. The parameters observed were the same as those monitored in the tests described above, i.e., I_{CEO}, low current beta, and breakdown voltages. Although shift in other parameters could be detected, I_{CEO} was by far the most sensitive. This was somewhat surprising since published results had led us to expect low current beta to be a strong function of surface conditions. On the other hand, the base surface plate does not completely overlap the emitter-base or collector-base junction so its effect on beta might not be expected to be as pronounded as on I_{CEO}.

Direct inversion tests were made using structures have n -type epitaxial layers in the resistivity range from 0.2 Ω-cm to 6 Ω-cm, and p -type diffused base regions. The test results are summarized in Table V.

TABLE V

RESULTS OF DIRECT CAPACITIVE INVERSION TESTS

n-Type (Homogeneous	Calculated Inversion Voltage	Measured Inversion Voltage
4 to 6 Ω-cm	-3 V	-15 V
0.5 Ω-cm	-11 V	-21 V
0.2 Ω-cm	-22 V	-28 V
p-Type (Diffused)		
120 Ω/□	+350 V	+140 V
240 Ω/□	+175 V	+70 V

Referring to the test results given in Table V, note that to invert n-type material, a voltage higher than the calculated value must be applied, whereas to invert p-type material, a voltage lower than the calculated value must be applied. There are two mechanisms responsible for this situation. One is the negative accumulation layer at the Si-SiO_2 interface which results from the positive charge (Q_{ss}) normally present in the SiO_2 layer. The other is that the segregation coefficients of boron and phosphorus in silicon and SiO are such that oxidized n surfaces are phosphorus-rich and oxidized p surfaces are boron-poor. Note that n-type silicon in the resistivity range of 4 to 6 Ω-cm, the range frequently used in high voltage analog devices, is susceptible to inversion with the voltages used in these circuits.

Although the use of this structure is generally quite straight-forward, the technique does have its limitations, the most important of which are described below.

To check the inversion test technique described above, a voltage of opposite polarity to that necessary for inversion was applied between the silicon and isolated metal on several units. Since this results in an accumulation layer rather than an inversion layer, one would not expect a channel current. As expected, no increase in monitor current was observed for surface plate voltages below 100 V. However, when the plate voltage exceeded 100 V, an increase in monitor current was observed. The following theory is advanced to explain the cause of this increase in current.

The monitor current is initially limited by the leakage current across the reverse biased p-n junction. An increase in current can result from two effects: (1) an inversion layer shunting the two junctions, or (2) an increase in the current through the reverse biased junction.

Since no inversion layer can be formed with the polarity applied, the junction leakage current must have increased.

The current through a reverse biased junction is determined by the equation

$$I_r = - \frac{qAD_p P_n}{L_p} + \frac{qAD_n N_p}{L_n}$$

where P_n and N_p are the assumed minority carrier concentrations in the n and p regions, respectively. Assume we are studying an n region, electrons in the p region will be attracted to the surface. This results in an increase in the minority carrier concentration, N_p, at the p surface of the silicon. Therefore, from the preceding equation, I_r will increase.

An experiment was performed to test the preceding theory. A device was constructed that had a field plate running over one p-n junction only. (See Figure 10) Since an increase in minority carrier concentration only affects a reverse biased junction, applying a field over this junction should result in an increase in monitor current. Applying a field over a forward biased junction should not increase the monitor current. If the monitor voltage is positive, P_2N will be reversed biased and will be affected by the field; however, if the monitor voltage is negative, P_2N will be reverse biased and not affected by the field.

The experiment demonstrated that the reverse biased junction leakage was affected by the applied field. As a result of this test, it has been suggested that the reverse biased junction current be monitored between p and n in addition to the p-region to p-region monitor current. The current due to inversion of the n region would then be the difference between the two currents.

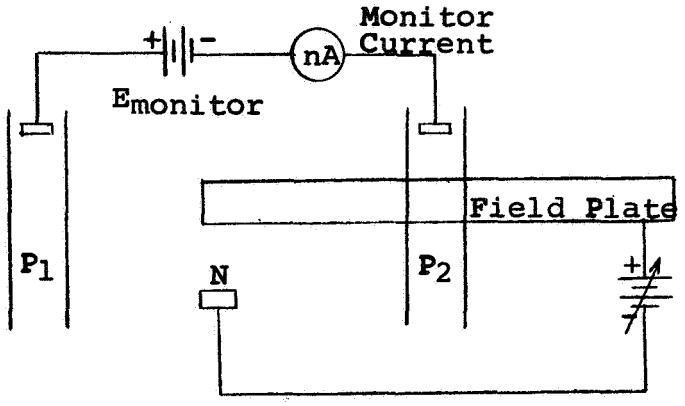

Figure 10. Test structure to determine influence of surface charge on junction leakage current.

4.3 SURFACE-FIELD-INDUCED INVERSION

In addition to the capacitive technique for obtaining surface charges, surface charge accumulation may occur when a field is set up on the surface of the planar oxide. Such a field can be created by applying a voltage between two isolated metalizations on the oxide surface. Any positive mobile ions should be attracted to the negative surface plate and negative mobile charge should be attracted to the positive surface plate. The resulting accumulation of charge on the oxide surface can influence the underlying silicon, in some cases, creating inversion layers.

4.4 TEST VEHICLE

As the results of the studies on the two test structures were obtained, it became obvious that such structures were capable of providing useful stability data. Available bipolar devices were still difficult to use in making rapid stability tests; thus it was necessary to redesign the test vehicle.

The final design of the vehicle retains standard diffusions and brings out electrical connections to standard bipolar devices, in addition to the improved stability sensing structures. The intent of relating stability of the Si-SiO_2 interface to actual bipolar devices is thus still retained. In addition to the increase in sensitivity obtained from the inclusion of the new structures, a standard wafer utilizing a higher resistivity epitaxial layer was chosen to further increase the sensitivity. The wafers used are the same as used to fabricate PA7709 circuits and were obtained from the production lines prior to metalization. Although the wafer used had transistors with BV_{CEO} values lower than the PA 7709 specifications, this parameter did not influence the tests made.

A photomicrograph of a glassed chip ready for assembly is shown in Figure 11b. Each pad on the device is numbered corresponding to the flat pack lead to which it is connected. The pad connections are listed below.

Device Pad and Flat Pack Lead No.	Connection To
1	Collector of test transistor.
2	Base of test transistor.
3	Surface plate to invert base of test transistor by capacitive (MOS) effect. Also to be used for inversion of base by accumulated surface charge.
4	Resistor for observation of n-region inversion.
5	Surface plate to invert underlying region by capacitive (MOS) effect. Also used for p and n inversion by accumulated surface charge.
6	Isolated "bucket" n region.
7	Base of control transistor.
8	Emitter of control transistor.
9	Isolation.
10	Collector of control transistor.
11	Field plate (on those units having field plates).
12	Surface plate for inversion of isolation by capacitive (MOS) effect. Also used for n-region inversion by accumulated surface charge.
13	No connection.
14	Emitter of test transistor.

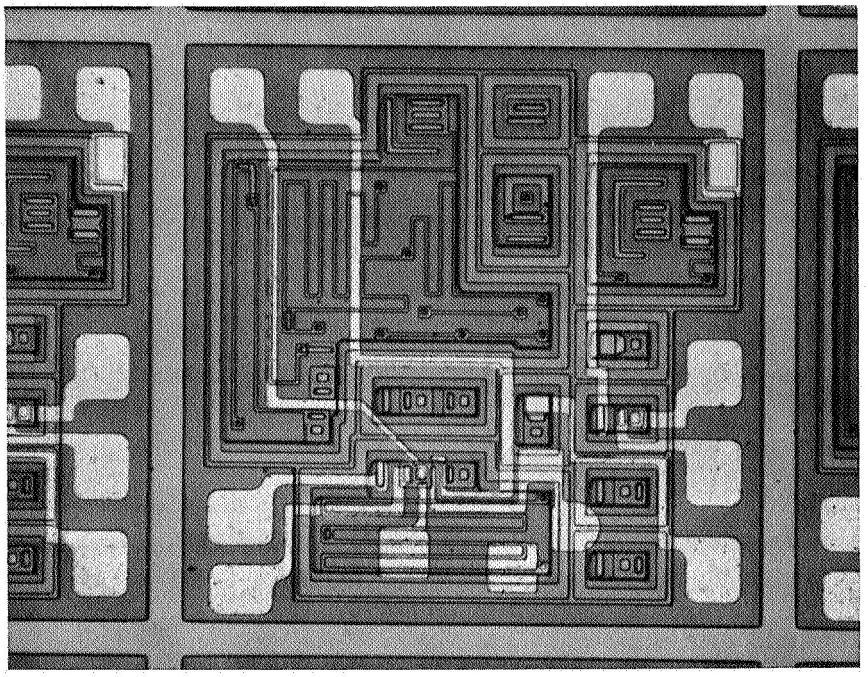

Figure 11a. Revised test device and metal pattern, before glassing.

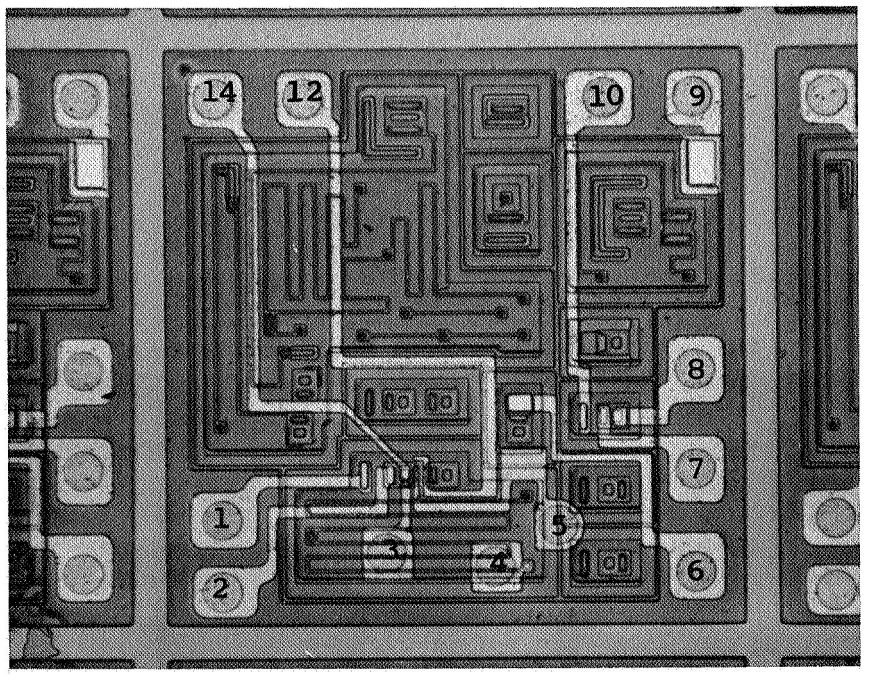

Figure 11b. Revised test device, after glassing and etching of contact cuts.

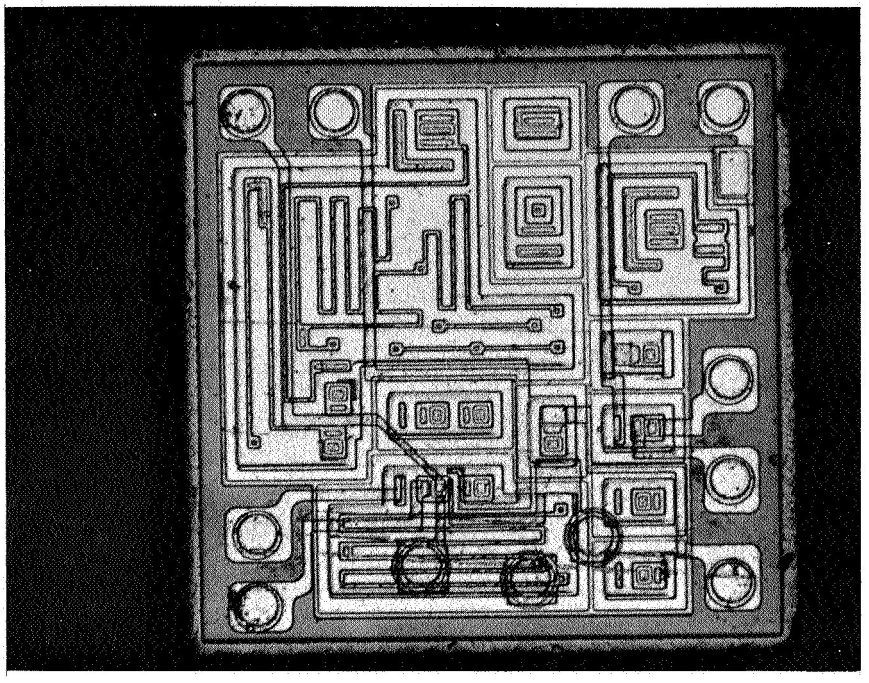

Figure 11c. Test device, showing addition of "field plate."

A photomicrograph of the chip before glass is shown in Figure 11a Note the absence of the circular contact cuts which are visible in Figure 11b. The addition of a field plate, a metal pattern completely covering the entire active region of the microcircuit, is shown in Figure 11c.

4.5 SUMMARY

Analyzing the results from the tests has been difficult. There are two ways to cause inversion of silicon: (1) by direct inversion, applying a voltage between a metal conductor on the surface of the oxide and the underlying silicon, or (2) by the accumulation of charge on the surface by applying a voltage between conductors on the surface of the oxide. Difficulties were encountered in applying conditions to cause one type of inversion without, at the same time, producing the other type. The outstanding difference between the two means of causing inversion is the degree of dependency upon time. Experiments have generally shown that capacitive inversion is an instantaneous effect, with inversion occurring immediately upon the application of a voltage, and disappearing immediately upon removal of that voltage. Surface-charge-induced inversion occurs with a time delay, since the mobility of the ions on the oxide surface is much lower than the mobility of charge in silicon and metal. For this reason, accumulated surface charge is retained for a considerable period of time after the applied voltage is removed.

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V - TASK 4 - MANUFACTURING STUDY

5.1 INTRODUCTION

This task had the purpose of determining which phase of the manufacturing process would be the most advantageous point for applying the glass encapsulation.

5.2 REASONS FOR GLASS APPLICATION

In deciding when to apply a protective layer, such as SiO_2, during the manufacturing process, the reasons for applying such a coating should be considered. These may include any or all of the following:

1. To protect the relatively soft aluminum metal used for interconnections on both bipolar and MOS devices;
2. To increase the dielectric layer thickness, thus reducing the capacitive effect between metal interconnects and the substrate;
3. To provide an insulating layer for use in depositing multilevel interconnections;
4. To provide protection from ambient contamination.

5.2.1 Protection for the Aluminum

In most manufacturing processes the wafer is reduced to individual microcircuit chips through a process of scribing and breaking. This frequently results in considerable damage to the aluminum interconnections because of abrasion from particles of silicon generated during the

operation. A protective layer, such as photoresist, has been shown to be helpful in reducing such damage. However, this organic must be removed before subsequent assembly. If a layer of glass were utilized in this manner it need not be removed after further processing. However, contact holes must be etched in the layer to permit connections to the underlying bonding pads.

5.2.2 Increasing Dielectric Thickness

A thick dielectric layer is frequently desirable to reduce the capacitive effect between metal layers, and between the metal layers and the substrate. The maximum thickness of the thermally grown oxides used in processing the active device is determined by the required device geometry. Thus the ability to deposit an additional dielectric layer following completion of the normal processing steps is desirable for reducing parastic coupling.

5.2.3 Providing an Insulating Layer

Within the past few years there has been an increasing demand for the ability to make metal interconnects of sufficient complexity when more than one layer of interconnection is required. The present bipolar integrated circuit technology has an inherent crossover capability in that a metal conductor can pass over a diffused resistor. It is required sometimes on bipolar devices and nearly always on MOS devices, that a high concentration, low resistance diffusion region be created specifically for crossover areas.

More complicated functions involving hundreds of components necessitate adding an insulating layer to completely cover the first normal level of metal. Through-connections (vias) are achieved by etching a path in the dielectric and continuing with the next level of metalization.

5.2.4 Protection from Ambient Contamination

As stated at the beginning of this sub section, a glass layer can provide significant protection of aluminum from mechanical damage. It has also been shown that the aluminum metal is quite susceptible to electrolytic corrosion when exposed to moist ambient conditions. This could occur in hermetically sealed enclosures which have failed and developed a leak as well as on chips packaged in a non-hermetic environment. Therefore, glass can provide desirable protection.

When considering the influence of ion migration on the surface of a microcircuit, it becomes desirable to place an additional dielectric layer over the complete microcircuit surface. This would inhibit the separation and migration of ions on the original oxide surface. Such charge separation can result from fringing fields as well as from lateral surface fields due to potential differences between metal conductors. Ion contamination would be further excluded from the substrate by the additional dielectric layer and would thus be less likely to cause a parameter change.

More complete freedom from ion migration can be achieved by the subsequent application of a phosphosilicate or a metal field plate. The phosphorus glass has been shown to act as an effective getter for sodium and hydrogen ions. A metal plate would eliminate the possibility of lateral fields.

5.3 DETERMINING POINT OF GLASS APPLICATION

From an economic viewpoint, a greater number of circuits can be glassed in wafer form than in a partially or completely assembled form, simply because of size. Moreover, the glass layer applied in wafer form will still provide the redundant protection desired for hermetically sealed devices. It should be noted that applying the glass to the wafer would not preclude the deposition of an additional glass coating following assembly. Although the latter deposition method would more completely coat the entire structure, it would have the disadvantage of undesirable depositions of glass on the peripheral members of the package. In addition, the assembled chip has temperature limitations imposed by the gold-silicon eutectic (melting point 367°C) frequently present in microcircuit assemblies.

The following considerations should be noted regarding bonding to a microcircuit chip which has been covered with a layer of glass. If the bonding pad is to be exposed by etching through the glass layer, the opening should be made somewhat smaller than the pad termination to guarantee that the etchant will not reach the normally present oxides. Such a condition could lead to undercutting in the critical bonding pad area. Therefore, the area for bonding on a glassed unit will be less than that on an unglassed one.

In addition, although more work is required in this area, it appears that thermocompression bonding to the exposed bonding pad is sometimes more difficult than ultrasonic bonding of aluminum wire. This is probably because the ultrasonic bonding breaks through any residual glass coating which may be present in the bonding area.

A possible solution for both of these problems would be the formation of the bonding pad on the top surface of the deposited coatings. A through connection or via requires less area than a bonding pad; hence the connection from the bonding pad to the underlying metal can be made without concern about the chip size. Such an approach, however, does imply additional processes, since two levels of metalization must be present.

5.4 SUMMARY

With so many possible utilizations of an additional coating in the fabrication of silicon integrated circuits, it would be desirable to employ a glassing process which would be broadly applicable to the many purposes for which glass can be utilized. It is therefore, recommended that depositing a SiO_2 layer by oxidation of silane is a proper selection as it permits the goals of this specific program to be achieved. A further recommendation is that the glass be deposited while the product is still in wafer form, before reduction to individual chips.

VI - TASK 5 - MANUFACTURE OF GLASS ENCAPSULATED DEVICES

6.1 INTRODUCTION

The purpose of this task was to use the design selected to manufacture a minimum of 300 semiconductor devices to be used in the evaluation tests described herein.

Judging by the studies conducted thus far, the improvement to be realized from glass encapsulation is clearly observable, i.e., mechanical protection of the aluminum interconnect pattern as well as chemical and electrolytic protection. Evidence of these improvements is fairly easily observed and is described in other sections.

A more complex aspect and consideration of the glass deposition is that it should not perturb the charge deposition existing in the underlying silicon or the oxide created during manufacturing. As discussed in the design section, it was felt desirable to select a test vehicle which would be most sensitive to charge modification. Therefore we selected the vehicle described in the previous section, which by virtue of its high resistivity, will permit the evaluation of the glass in terms of electrical performance. It must be kept in mind that the intent of the glass is not to correct or change charge distributions in a semiconductor device but rather to maintain the quality of the device as manufactured.

6.2 TEST VEHICLE

To provide enough terminals, a standard 14-lead flat pack was used. In those cases where it was intended to simulate an unsealed package, a hole was pierced in the flat pack lid located directly

over the chip location. This permitted visual inspection of the device during tests. The device is pictured in the design section (IV) and more detail on the tests is given in Appendix B under the R&QC evaluation report. A breakdown of the various groups manufactured for this test is as follows:

A. Glassed

1. Sealed

2. Open

B. Unglassed

1. Sealed

2. Open

The quantities in these groups are shown in the above mentioned section of the appendix.

The basic wafers were selected from the manufacturing line and were rejects for the minimum BV_{CEO} specification of the specific product. The product represented surface properties which were considered necessary for this test vehicle. The metalization and glassing were conducted in the laboratory. Following diesort and selection of chips for assembly, the units were fabricated in the normal factory manufacturing facility.

Screening tests normally performed in production were omitted so that the test program as outlined could be used to determine any differences with might occur as a result of glass encapsulation. The sealing technique used on these flat packs consists of a braze between the Kovar lid and braze flange. A sealing temperature of $320^{o}C$ is used for these products. A total of some 500 finished units were initially tested and units were selected from this group for submission to the performance and evaluation test.

6.3 DEMONSTRATION MODEL

While not a specific requirement of this program, it was considered advisable to demonstrate the manufacturing process for glass encapsulation as applied to the same integrated circuit used as a test vehicle but interconnected as a standard product. These units were delivered along with a reference manual describing their assembly and packaging and the several functional tests by which they were selected. Five of the units had lids with openings to permit visual inspection of the assembly.

Visual detection of a glassed chip is generally associated with a lack of oxide color differences since the relatively thick glass tends to eliminate the otherwise colorful oxide surface. These models were presented during a visit to NASA, Huntsville, in August, 1967.

VII - TASK 6 - PERFORMANCE EVALUATION OF GLASS ENCAPSULATED DEVICES

7.1 INTRODUCTION

The purpose of this task was the performance of a complete electrical and mechanical design analysis and evaluation on devices containing the glass passivation. The analysis and evaluation took into consideration the environments to which the devices may be exposed in usage. Tests were so designed and performed as to yield maximum information. The failure modes and mechanisms due to glass encapsulation and their detection and prevention were to be determined.

7.2 TEST VEHICLES

7.2.1 Types of Test Vehicles

The test vehicles subjected to evaluation during the course of this contract consisted primarily of the glassed and unglassed devices mounted in open and in hermetically sealed 14-lead, 1/4" x 1/4" metal bottom flat packages. The combinations of the above resulted in four different basic assemblies:

a. Unglassed chips mounted in open packages,

b. Glassed chips mounted in open packages,

c. Unglassed chips mounted in hermetic packages,

d. Glass chips mounted in hermetic packages.

A minor portion of the program was devoted to the evaluation of glassed devices with field plates mounted in:

a. Open 1/4" x 1/4" metal bottom flat packs, and

b. Hermetically sealed 1/4" x 1/4" metal.

7.2.2 Basic Chips

The basic construction of the chip is shown in Figure 11b. This photograph depicts a glassed circuit, but the active component layout is identical for both the unglassed and the glassed-with-field plate vehicles. In the case of the glassed devices, the entire surface of the chip is covered with glass, vapor plated from a silane source; and in the case of the glassed-with-field-plate devices, the vapor plated glass over the active area of the device is covered with an evaporated aluminum film. In all glassed devices, electrical contact to the metalization pads, evaporated on the surface, of the thermally grown oxide, was achieved by etching circular cuts through the vapor plated glass to the pad, and ultrasonically bonding an aluminum whisker wire from the field plate to package pin number 11.

The pin terminations, applicable to all types of devices are

Pin 1 - Collector, test transistor

Pin 2 - Base, test transistor

Pin 3 - Inversion plate - test transistor base region

Pin 4 - Resistor

Pin 5 - Inversion plate - "N" epitaxial region

Pin 6 - Collector bucket

Pin 7 - Base Control transistor

Pin 8 - Emitter Control transistor

Pin 9 - Isolation region

Pin 10 - Collector Control transistor

Pin 12 - Surface Inversion plate

Pin 14 - Emitter, Test transistor

and, in the case of the glassed field plate devices,

Pin 11 - field plate.

7.3 SCREENING SEQUENCE

All of the devices fabricated as a part of this contract were 100% screened to:

a. Stabilize the electrical characteristics

b. Remove potential mechanical failures.

The screens to which the devices were subjected, in the sequence in which they were performed, and the purpose of each are described below.

7.3.1 Stabilization Bake

Stabilization bake involved subjecting the devices to 16 hours at 200°C. Evaluations performed on internal wire bonds indicated that there can be degradation of both gold and aluminum bond strength during high temperature storage. These tests also indicated that the "as bonded" strengths degrade quite rapidly initially, and generally stabilize after a short duration. Evaluation of parameter data taken both prior to and after 200°C storage indicated that some lots experience parameter changes while others do not. The purpose of this screen was therefore

1. To accelerate degradation of any marginal wire bonds so that the devices can be made to fail during subsequent mechanical testing and the bad devices can be removed during electrical testing.
2. To stabilize the electrical characteristics of the devices so that parameter variations do not occur during subsequent electrical test solely because of insufficient conditioning.

7.3.2 Temperature Cycling

This involved subjecting devices to 10 cyles -65°C to +200°C, 30 minutes at each temperature extreme, 5 minutes transfer between high and low temperature.

The intent of this screen was to induce failure of defective chip-to-header bonds, metalization defects and poor whisker wire bonds. Our experience has shown that temperature cycling is effective in the removal of devices with defects in the interconnecting metalization at oxide steps, provided a sufficient number of cycles are performed. The type of defects the screen removes are not normally observed during preseal visual inspection.

7.3.3 Thermal Shock

This testing subjects devices to 10 cycles, -65°C to +200°C, 5 minutes at each temperature extreme, immediate transfer. This test is conducted by cycling the devices between high and low temperature baths, and because the heat capacity of these baths is greater than air chambers, the thermal stresses imposed are applied to the device much more rapidly. The intent of the screen was to induce failure of defective chip-to-header bonds, metalization defects and poor whisker wire bonds, by causing rapid differential changes in the dimensions of dissimilar materials at the mating interface of these materials because of differences on the thermal coefficient of expansion. It should be noted that, in general, unsealed devices were not subjected to this screen to avoid contamination by the oil used as the temperature exchange mechanism.

7.3.4 Vibration Variable

This test involved 30 "G" according to MIL-STD-750, Method 2056. This screen was imposed to remove devices so assembled that they would fail during use because of excitation of resonant frequencies.

7.3.5 Mechanical Shock

This test subjected devices to 6000 G (pneupactor), Y1 and Y2 planes only. This screen was intended to induce failure of any devices which have defective chip-to-header bonds, or defective internal wire bonds. The screen was performed after the thermal screen to insure removal of any devices which had experienced degradation of mechanical properties during thermal screening. It was performed in the Y1 direction because this is the plane most likely to cause failure of mechanically weakened wire and chip bonds, and in the Y2 plane because this direction induces shorting of excessively long internal leads to the metal header, thus facilitating removal of this type of failure during subsequent electrical testing.

7.3.6 Constant Acceleration

In this test, devices underwent constant acceleration at 20,000 G, Y1 & Y2 planes only. This screen was intended to remove devices with the same types of defects as described in 7.3.5. However, in this case the stress is applied gradually over a relatively long duration, rather than the rapidly applied short duration force which occurs during shock testing.

7.4 EVALUATION TESTING

After completion of the 100% screens, some devices of each type were subjected to Moisture Resistance testing in accordance with MIL-STD-750, Method 1021.1. The devices which survived this test were subsequently subjected to an additional 240 hours of reverse bias testing while being simultaneously subjected to the moisture resistance test. The purpose of this testing was to determine the effects of the most available atmosphere contaminant on semiconductor surfaces protected by

a. The thermally grown oxide

b. The thermally grown oxide and vapor plated glass

c. The thermally grown oxide and hermetic packaging

d. The thermally grown oxide, and vapor plated glass, and hermetic packaging.

Devices of all types which had been subjected to the screening sequence, but had not been subjected to the moisture testing were split into two groups and were subjected to reverse bias testing. One group was operated at 25°C and the other was operated at 75°C. A detailed discussion of the results of this testing is given in the following paragraphs.

7.4.1 Evaluation Testing Results

Two groups of devices were fabricated during the course of this contract. The original group of devices was subjected to the testing indicated in paragraph 7.4.1.1 and a second group of devices was subjected to the testing indicated in paragraph 7.4.1.2. The fabrication of the second group of devices was necessitated when a large percentage of the original group of devices was damaged during life testing.

7.4.1.1 In Process Screening & Evaluation Testing of the Original Group of Devices.

All of the devices fabricated were subjected to a 100% electrical inspection. Upon completion of this testing, all devices which failed arbitrarily established limits were removed. (See TABLE VI.)

The remaining devices were serialized so that the first digit of the 3-digit serialization indicated the wafer from which the device was fabricated and the second and third digits indicated the type of construction used in the fabrication of the device according to the following code:

X000 - X24* Unglassed, nonhermetically-sealed devices

X25 - X49 Glassed, nonhermetically sealed devices

X50 - X74* Unglassed hermietically sealed devices

X75 - X99 Glassed hermetically sealed devices

NOTE: "X" represents any integer.

* 700 - 724 are glassed with field plates in nonhermetic package

800 - 824 are glassed with field plates in nonhermetic package

* 750 - 774 are glassed with field plates in hermetic package

850 - 874 are glassed with field plates in hermetic package

These devices were then subjected to the electrical measurements, environmental screens and life tests as indicated in Table VI .

The results of this testing on the original devices, together with the quantities of devices subjected to each test, are summarized in Table VIII. No data is listed for the operating life tests because a large percentage of these devices were damaged and the test was discontinued.

TABLE VI

SCREENING AND TEST SEQUENCE
FOR ORIGINAL GROUP OF DEVICES

Electrical Measurements per
Specification given in Table VII

↓

Stabilization Bake -
16 Hours, 200°C

↓

Electrical Measurements
per Table VII

↓

Temperature Cycling, 10 cycles, -65 to +200°C
30 Minutes each temperature extreme, 5 minutes
transfer (maximum)

↓

Electrical Measurements
per Table VII

↓

Vibration Variable - 30 "G"
MIL-STD-750 Method 2056

↓

Electrical Measurements
per Table VII

↓

Mechanical Shock -
6000 "G" (Pneupactor) Y1 & Y2 planes only

↓

Electrical Measurements
per Table VII

↓

Constant Acceleration, 20,000 "G"
Y1 & Y2 planes only

↓

Electrical Measurements
per Table VII

↓

Moisture Resistance; 10 days
MIL-STD-750, Method 1021.1
followed by 1 hour, 125°C Bake

↓

Electrical Measurements
per Table VII

↓

Moisture Resistance, 10 days
per MIL-STD-750 Method 1021.1
while operation in the reverse
bias circuit of Figure 12

↓

Electrical Measurements
per Table VII

Reverse Bias Operation
at 25°C

Reverse Bias Operation
at 75°C

TABLE VII

ELECTRICAL PARAMETERS MEASURED ON ORIGINAL GROUP OF DEVICES

Card 1	1 Unit #	IRG09 AMP	IGRO4 AMP	IBRO4 AMP	IRBO2 AMP	IGBO2 AMP	IBGO9 AMP	IRCO1 AMP	ICBO1 AMP	ICGO1 AMP	ICEO1 AMP
	Test #	1	2	3	4	5	6	7	8	9	10

Parameter	Component	Conditions	Measure	Range Units
1. I_{RGO}	Resistor-Isolation	Pin 9 = 10V, Pin 4 = Gnd	I at Pin 9	1 μA
2. I_{GRO}	Isolation-Resistor	Pin 4 = 10V, Pin 9 = Gnd	I at Pin 4	1 μA
3. I_{BRO}	Base-Resistor	Pin 4 = 10V, Pin 2 = Gnd	I at Pin 4	1 μA
4. I_{RBO}	Resistor-Base	Pin 2 = 10V, Pin 4 = Gnd	I at Pin 2	1 μA
5. I_{GBO}	Isolation-Base	Pin 2 = 10V, Pin 9 = Gnd	I at Pin 2	1 μA
6. I_{BGO}	Base-Isolation	Pin 9 = 10V, Pin 2 = Gnd	I at Pin 9	1 μA
7. I_{RCO}	Resistor-Collector	Pin 1 = 10V, Pin 4 = Gnd	I at Pin 1	1 μA
8. I_{CBO}	Test Transistor	Pin 1 = 10V, Pin 2 = Gnd	I at Pin 1	1 μA
9. I_{CGO}	Collector-Isolation	Pin 1 = 10V, Pin 9 = Gnd	I at Pin 1	1 μA
10. I_{CEO}	Test Transistor	Pin 1 = 10V, Pin 14 = Gnd	I at Pin 1	1 μA

TABLE VII (Continued)

ELECTRICAL PARAMETERS MEASURED ON ORIGINAL GROUP OF DEVICES

Card 2	2 Unit #	ICEOT AMP	IEBOT AMP	BETAT AMP	BETAT AMP	ICBOC AMP	ICEOC AMP	IECO8 AMP	IEBO8 AMP	BETAC AMP	BETAC AMP
	Test #	11	12	13	14	15	16	17	18	19	20

Parameter	Component	Conditions	Measure	Range Units
11. I_{ECO}	Test Transistor	Pin 14 = 1 V, Pin 1 = Gnd	I at Pin 14	1 μA
12. I_{EBO}	Test Transistor	Pin 14 = 5 V, Pin 2 = Gnd	I at Pin 14	1 μA
13. BETA	Test Transistor	Pin 1 = 5 V, Pin 2 = 1 μA, Pin 14 = Gnd	I at Pin 1	100 μA
14. BETA	Test Transistor	Pin 1 = 5 V, Pin 2 = 10μA, Pin 14 = Gnd	1 at Pin 1	1 mA
15. I_{CBO}	Control Transistor	Pin 10 = 10V, Pin 7 = Gnd	I at Pin 10	1 μA
16. I_{CEO}	Control Transistor	Pin 10 = 10V, Pin 8 = Gnd	I at Pin 10	1 μA
17. I_{ECO}	Control Transistor	Pin 8 = 1 V, Pin 10 = Gnd	I at Pin 8	1 μA
18. I_{EBO}	Control Transistor	Pin 8 = 5V, Pin 7 = Gnd	I at Pin 8	1 μA
19. BETA	Control Transistor	Pin 10 = 5V, Pin 7 = 1 μA, Pin 8 = Gnd	I at Pin 10	100 μA
20. BETA	Control Transistor	Pin 10 = 5V, Pin 7 = 10 μA, Pin 8 = Gnd	I at Pin 10	1 mA

TABLE VII (Continued)

ELECTRICAL PARAMETERS MEASURED ON ORIGINAL GROUP OF DEVICES

Card 3	3 Unit #	IC1C2 AMP	IC2C1 AMP	IC6GO AMP	BETAI AMP	BETAI AMP	BVCBO AMP	IL3 AMP	IL5 AMP	IL12 AMP	IL11 AMP
	Test #	21	22	23	24	25	26	27	28	29	30

Parameter	Component	Conditions	Measure	Range Units
21. $I_{C_1C_2O}$	Collector-Collector	Pin 1 = 10V, Pin 6 = Gnd	I at Pin 1	1 μA
22. $I_{C_2C_1O}$	Collector-Collector	Pin 6 = 10V, Pin 1 = Gnd	I at Pin 6	1 μA
23. I_{C_6GO}	Collector-Isolation	Pin 6 = 36V, Pin 9 = Gnd	I at Pin 6	1 μA
24. $BETA_I$	Test Transistor	Pin 14 = 1V, Pin 2 = 10 μA, Pin 1 = Gnd	I at Pin 14	10 μA
25. $BETA_I$	Test Transistor	Pin 14 = 1V, Pin 2 = 20 μA, Pin 1 = Gnd	I at Pin 14	10 μA
26. BV_{CBO}	Test Transistor	Pin 1 = 100 μA (positive), Pin 2 = Gnd	V at Pin 1	100 V
27. I_{L_3}	Surface Plate Isolation	Pins 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 14 = Gnd, Pin 3 = +36 V	I at Pin 3	1 μA
28. I_{L_5}	Surface Plate Isolation	Pins 1, 2, 3, 4, 6, 7, 8, 9, 10, 12, 14 = Gnd, Pin 5 = +36 V	I at Pin 5	1 μA
29. I_{L-12}	Surface Plate Isolation	Pin 1 = Gnd, Pin 12 = +1 V	I at Pin 12 (limit)	1 μA
30. I_{L-11}	Field Plate Isolation	Pins 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14 = Gnd Pin 11 = + 36 V	I at Pin 11 (limit)	1 μA

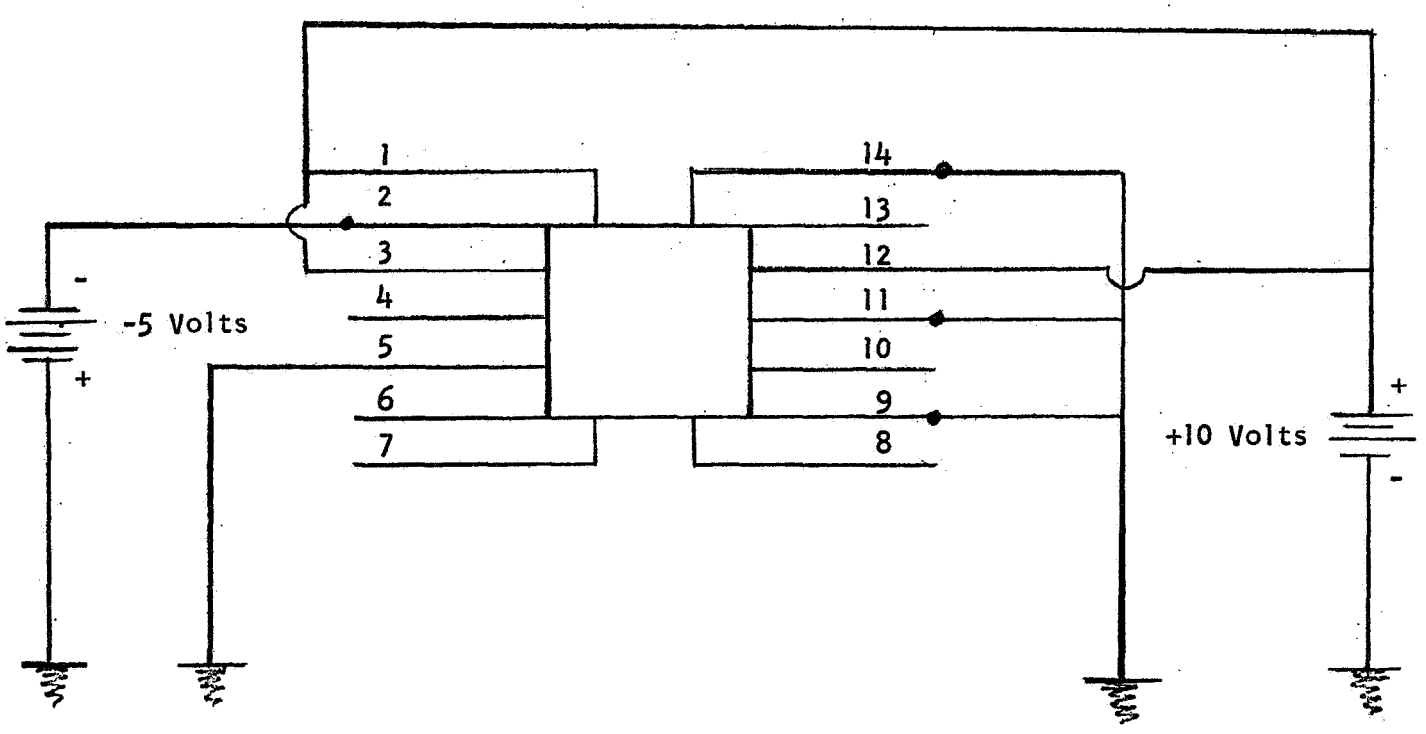


Figure 12. Schematic drawing of test circuit used during moisture resistance with bias testing.

TABLE VIII

ENVIRONMENTAL SUMMARY, ORIGINAL DEVICES

(Failures are Cumulative)

	Sample	200°C Stabilization Bake	Temperature Cycle +200 - -65°C	Thermal Shock +200 - -65°C	Vibration Variable 30 G	Mechanical Shock 6 kG	Constant Acceleration 20 kG	Moisture Resistance	Moisture Resistance with Bias
Test A									
Unglassed Sealed	10	0	0	0	0	3	3	4	8
Glassed Sealed	8	0	0	0	0	0	0	0	7
Field Plate Sealed	1	0	0	0	0	0	0	1	1
Test B									
Unglassed Sealed	56	0	1	3	4	16	22	--	--
Glassed Sealed	41	0	0	0	0	5	6	--	--
Field Plate Sealed	43	1	3	5	6	11	13	--	--
Field Plate Open	7	0	1	2	2	3	3	--	--
Test C									
Unglassed Open	13	0	1	--	1	3	4	8	12
Glassed Open	12	0	0	--	0	3	3	6	11
Field Plate Open	1	0	0	--	0	0	0	1	1
Test D									
Unglassed Open	54	2	2	--	5	7	10	--	--
Glassed Open	58	0	1	--	1	9	15	--	--
Field Plate Open	28	1	1	--	1	3	5	--	--

7.4.1.2 In Process Screening & Evaluation Testing of the Second Group of Devices.

A second group of devices was fabricated, and electrically measured according to the specification given in Table IX. The devices that did not meet the limits imposed by this specification were removed from the group and the remaining devices were serialized as follows:

The first digit of the 3-digit serialization indicates the wafer from which the devices were fabricated. The second and third digits indicate the construction.

X01-X24 - Unglassed* nonhermetically sealed devices

X25-X49 - Glassed, nonhermetically sealed devices

X50-X74 - Unglassed*, Sealed

X75-X99 - Glassed, Sealed

* 011-024 are glassed with field plates in nonhermetic packages

401-424 are glassed with field plates in nonhermetic packages

701-724 are glassed with field plates in nonhermetic packages

801-824 are glassed with field plates in nonhermetic packages

050-074 are glassed with field plates in hermetic packages

450-474 are glassed with field plates in hermetic packages

750-774 are glassed with field plates in hermetic packages

850-874 are glassed with field plates in hermetic packages

These devices were subjected to the screening sequence shown in Table X.

TABLE IX

ELECTRICAL PARAMETERS MEASURED ON SECOND GROUP OF DEVICES

Parameter	Description	Conditions	Parameter Limits Min.	Parameter Limits Max.	Test Limits
1. I_{RGO9}	Resistor-Isolation Channel or Resistor Diode	Pin 9 = +10V, Pin 4 = Gnd	----	1μA	45 μA
2. I_{GRO4}	Resistor-Isolation Channel or Collector-Isolation Diode	Pin 4 = +10V, Pin 9 = Gnd	----	1μA	45 μA
3. I_{BRO4}	Base-Resistor Channel or Base-Collector Diode	Pin 4 = +10V, Pin 2 = Gnd	----	1μA	45 μA
4. I_{RBO2}	Base-Resistor Channel or Resistor Diode	Pin 2 = +10V, Pin 4 = Gnd	----	1μA	45 μA
5. I_{GBO2}	Isolation-Base Channel or Collector Isolation Diode	Pin 2 = +10V, Pin 9 = Gnd	----	1μa	
6. I_{BGO9}	Base-Isolation Channel or Base-Collector Diode	Pin 9 = +10V, Pin 2 = Gnd	----	1μA	45 μA
7. R_{RCO1}	Resistor-Collector Diode	Pin 1 = +10V, Pin 4 = Gnd	----	1μA	45 μA
8. I_{CBO1}	Base-Collector Diode	Pin 1 = +10V, Pin 2 = Gnd	----	1μA	45 μA
9. I_{CGO1}	Collector-Isolation	Pin 1 = +10V, Pin 14 = Gnd	----	1μA	45 μA
10. I_{CEO1}	Collector-Emitter Channel or Collector-Base Diode	Pin 1 = +10V, Pin 14 = Gnd	----	1μA	45 μA

TABLE IX (Continued)

ELECTRICAL PARAMETERS MEASURED ON SECOND GROUP OF DEVICES

Parameter	Description	Conditions	Parameter Limits Min.	Parameter Limits Max.	Test Limits
11. I_{ECOT}	Collector-Emitter Channel on Emitter Base Diode	Pin 14 = +10V, Pin 1 = Gnd	----	1μA	90 μA
12. I_{EBOT}	Emitter Base Diode	Pin 14 = +5 V, Pin 2 = Gnd	----	1μA	50 μA
13. $BETA_L$	Low Current β	Pin 1 = +5 V, Pin 2 = 1μA, Pin 14 = Gnd	1μA	----	500 μA
14. $BETA_H$	Higher Current β	Pin 1 = +5V, Pin 2 = 10μA, Pin 14 = Gnd	10μA	----	5 mA
15. I_{CBOC}	Collector-Base Diode (control)	Pin 10 = +10V, Pin 7 = Gnd	----	1μA	45 μA
16. I_{CEOC}	Collector-Emitter Channel or Collector-Base Diode (control)	Pin 10 = +10V, Pin 8 = Gnd	----	1μA	41 μA
17. I_{ECO8}	Collector-Emitter Channel or Emitter-Base Diode (control)	Pin 8 = +1V, Pin 10 = Gnd	----	1μA	90 μA
18. I_{EBO8}	Emitter-Base Diode (control)	Pin 8 = +5V, Pin 7 = Gnd	----	1μA	50 μA
19. $BETA_{CL}$	Low Current β (control)	Pin 10 = +5V, Pin 7 = 10μA, Pin 8 = Gnd	1μA	----	50 μA
20. $BETA_{CH}$	Higher Current β (control)	Pin 10 = +5V, Pin 7 = 10μA, Pin 8 = Gnd	1μA	----	5 mA

TABLE IX (Continued)

ELECTRICAL PARAMETERS MEASURED ON SECOND GROUP OF DEVICES

Parameter	Description	Conditions	Parameter Limits Min.	Parameter Limits Max.	Test Limits
21. I_{CIC2}	Collector-Collector Channel or Collector-Isolation Diode	Pin 1 = +10V, Pin 6 = Gnd	----	1μA	45 μA
22. I_{C2C1}	Collector-Collector Channel or Collector 6-Isolation Diode	Pin 6 = +10V, Pin 1 = Gnd	----	1μA	45 μA
23. I_{C6GO}	Collector-6-Isolation Diode	Pin 6 = +36V, Pin 9 = Gnd	----	----	14 μA
24. $BETA_{CL}$	Inverse β (control)	Pin 8 = +1V, Pin 7 = 20 μA, Pin 10 = Gnd	1μA	----	90 μA
25. $BETA_{T1}$	Inverse β	Pin 14 = +1V, Pin 2 = 20 μA, Pin 1 = Gnd	1μA	----	90 μA
26. I_{DSL}	Low Current Transconductance	Pin 1 = +36V, Pin 2 = 36V, Pin 3 = 10V, Pin 4 = 30V, Pin 5 = 10V	----	----	200 μA
27. I_{DSH}	Higher Current Transconductance	Pin 1 = +36V, Pin 2 = 36V, Pin 3 = Gnd	1μA	----	200 μA
28. I_{L5}	Surface Plate 5 Isolation	Pin 5 = +36V, Pins 1, 2, 3, 4, 6, 7, 8, 9, 10, 12, 14 = Gnd	----	1μA	45 μA
29. I_{L3-12}	Surface Plate 12 Isolation	Pins 3 & 12 = +36V, Pins 1, 2, 4, 5, 6, 7, 8, 9, 10, 14 = Gnd	----	1μA	45 μA
30. I_{1-11}	Field Plate Isolation	Pin 11 = -36V, Pins 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14 = Gnd	----	1μA	45 μA

TABLE X

SCREENING SEQUENCE FOR SECOND GROUP OF DEVICES

Electrical Measurements per
Specification of Table IX

↓

Stabilization Bake
16 Hours, 200°C

↓

Temperature Cycling
10 cycles, -65°C to +200°C
30 minutes at each temperature
extremes, 5 minutes transfer (max)

↓

Thermal Shock, (hermetically sealed
devices only) 10 cycles, -65°C to +200°C
5 minutes at each temperature extreme
Immediate transfer

↓

Vibration Variable - 30 "G"
MIL-STD-750, Method 2056

↓

Mechanical Shock, 6000 "G"
(Pneupactor) Y1 & Y2 planes only

↓

Constant Acceleration, 20,000 "G"
Y1 & Y2 planes only.

↓

Electrical Measurements per
Specification of Table IX.

These devices were not electrically measured between each environmental step because sufficient information to determine the effectiveness of each screen was obtained during the evaluation of the original group of devices.

Upon completion of the screening sequence, the failures from this group of devices were removed and subjected to analysis to determine the failure mode and mechanism.

A summary of the results of the screening sequence is given in Table XI.

TABLE XI

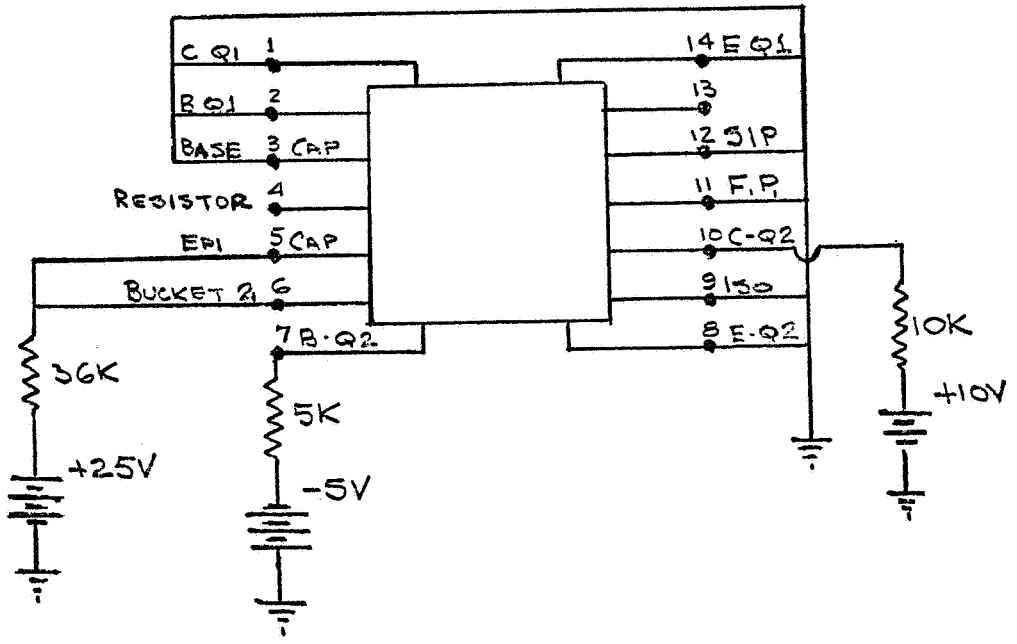
ENVIRONMENTAL TEST SUMMARY FOR SECOND GROUP OF DEVICES (TEST SEQUENCE SHOWN IN TABLE X)

	Unglassed Open		Glassed Open		Unglassed Sealed		Glassed Sealed		Field Plate Open		Field Plate Sealed		Totals		Com-bined
	New	Orig.	New	Orig	New	Orig.	New	Orig	New	Orig.	New	Orig.	New	Orig	
Devices Subjected to Initial Meas. After 100% Elec. Screen	40	18	67	26	43	13	70	24	9	1	4	0	233	82	315
Failed Initial Measurement	5	5	12	3	8	3	3	3	1	1	0	--	29	15	44
Subjected to Env. Screens	35	--	55	--	35	--	67	--	8	--	4	--	204	--	---
Failed Env. Screens	11	--	7	--	12	--	17	--	1	--	2	--	50	--	---
Devices Subjected to Elec. Meas. Prior to Life Test After 25°C Shelf Life	--	13	--	23	--	10	--	21	--	0	--	--	--	67	---
Failed Elec. Meas. Prior to Life Test After 25°C Shelf Life	--	1	--	1	--	1	--	3	--	--	--	--	--	6	---

Prior to the initial electrical screen of the second group of devices, the survivors of the original group of devices were subjected to 300°C Storage for 16 hours to bake-out any inversion effects induced by the short reverse bias life testing to which they were subjected in the original test sequence. Subsequent to the 300°C Bake, the devices were electrically measured with the devices of the second group during the initial electrical screen. The devices which did not meet the requirements of the electrical specification, Table IX, were removed. The original devices were reserialized according to the code given in paragraph 7.4.1.2 and retained in room temperature storage, until the second group of devices were electrically measured after completion of the environmental sequence of Table X and were remeasured. This data is also summarized in Table XI .

The original and the second group of devices were then combined and subjected to reverse bias operational testing. A total of 30 original and 76 new devices from the new group were subjected to 25°C reverse bias testing and 29 original and 79 new devices from the second group were subject to 75°C reverse bias testing. The circuit utilized for both tests is shown in Figure 13.

Parameter measurements were made at 340, 694, 1000, and 4000 hours according to the specification of Table IX. When parameter measurements were made on the devices subjected to 75°C testing, they were cooled to room temperature prior to removal of the bias so that if inversion had occurred during the life test the charge would be frozen so it could be detected at electrical test. All devices were electrically measured as soon as the life test bias was removed and were returned to the life test rack as soon as the measurements were completed. The data obtained is summarized in Table XII.



NOTE: The life test positions are wired in parallel on 14-position mother boards. To eliminate the possibility of damage to the test vehicles when inserting the mother boards into the test sockets, the power supply lines are opened through a switch arrangement, as indicated. To minimize the possibility of device damage because of high current surges, resistors are inserted into the supply lines.

Figure 13. Reverse bias operational life test circuit.

TABLE XII

LIFE TEST SUMMARY, ORIGINAL AND NEW DEVICES

(Failures Not Cumulative)

		UNGLASSED OPEN		GLASSED OPEN		UNGLASSED SEALED		GLASSED SEALED		FIELD PLATE OPEN		FIELD PLATE SEALED		TOTAL	
		New	Orig	New	Orig	New	Orig	New	Orig	New	Orig	New	Orig	New	Orig
25°C Operating Test	Sample	12	8	23	9	13	7	24	6	3	0	1	0	76	30
	Failures at 340 hours	0	0	0	0	1	1	0	0	0	0	0	0	1	1
	Failures at 694 hours	2	1	1	0	0	0	0	0	1	0	0	0	4	1
	Failures at 1000 hours	0	1	0	0	0	0	0	0	0	0	0	0	0	1
	Failures at 4000 hours	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75°C Operating Test	Sample	12	3	26	12	10	2	26	12	4	0	1	0	79	29
	Failures at 340 hours	0	0	0	5	0	1	0	1	0	0	0	0	0	7
	Failures at 694 hours	1	1	2	0	0	0	1	2	0	0	0	0	4	3
	Failures at 1000 hours	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Failures at 4000 hours	0	0	2	1	0	0	0	0	0	0	0	0	2	1

7.5 STATISTICAL DATA ANALYSIS

Utilizing electronic computer techniques, the data derived initially, and after 340, 694, 1000, and 4000 hours of reverse bias testing at both room temperature and at 75°C, was statistically processed to obtain:

a. The mean value for each parameter at each reading period,

b. The standard deviation for each parameter at each reading period,

c. The high value for each parameter at each reading period,

d. The low value for each parameter at each reading period, and

e. A numerical representation of the frequency distribution for each parameter at each reading period.

This statistical information is included in Appendix B. It should be noted however, that these calculations are based on the parameter values measured only on devices which meet the limits specified in Table IX. The data from any device which did not meet the limits specified in this table was not utilized in the statistical calculations.

During the course of the analysis of the failures incurred during the testing, it was discovered that most of the failures involved only certain parameters.

The parameters which caused device failure were:

a. I_{RG09}

b. I_{GR04}

c. I_{BR04}

d. I_{RB02}

e. I_{GB02}

f. I_{BG09}

g. I_{L5}

h. I_{L12}

i. I_{C1C2}

j. I_{C2C1}

k. B_{TATL} & B_{TACL}

l. B_{TATH} & B_{TACH}

m. I_{C6G0}

To determine if there were any significant parameter change trends, the data obtained during life testing was subjected to a computer oriented analysis to determine the mean value of each test parameter. During this determination the data from the electrically defective devices was neglected. The mean value of each of the parameters indicated above as being responsible for or related to failure was then plotted as a function of test duration (Figures 14 through 26). These plots showed significant trends only in the cases of:

a. I_{BR04} and I_{RB02} for unglassed nonhermetically sealed devices subjected to room temperature operational testing. The mean value of these parameters showed a substantial increase in value after 1000 hours of test, but recovered to the initial level after completion of 4000 hours of test.

b. I_{C2C1} for unglassed and glassed, nonhermetically sealed device subjected to room temperature operational testing and for glassed, nonhermetically devices subjected to 75°C operation. This parameter is related to I_{C6G0} which also showed a significant increase for the same parameters. The reason for these changes is thought to be inversion which is discussed in more detail in a later section.

c. High and low current beta for all device constructions during both room temperature and 75°C operation. The change is more predominant however at 25°C. The peculiarity observed from the beta plots is that the parameter indicates a decrease in value for the control transistor which was not biased during the test, and a relatively stable value for the test transistor, which was biased during the test.

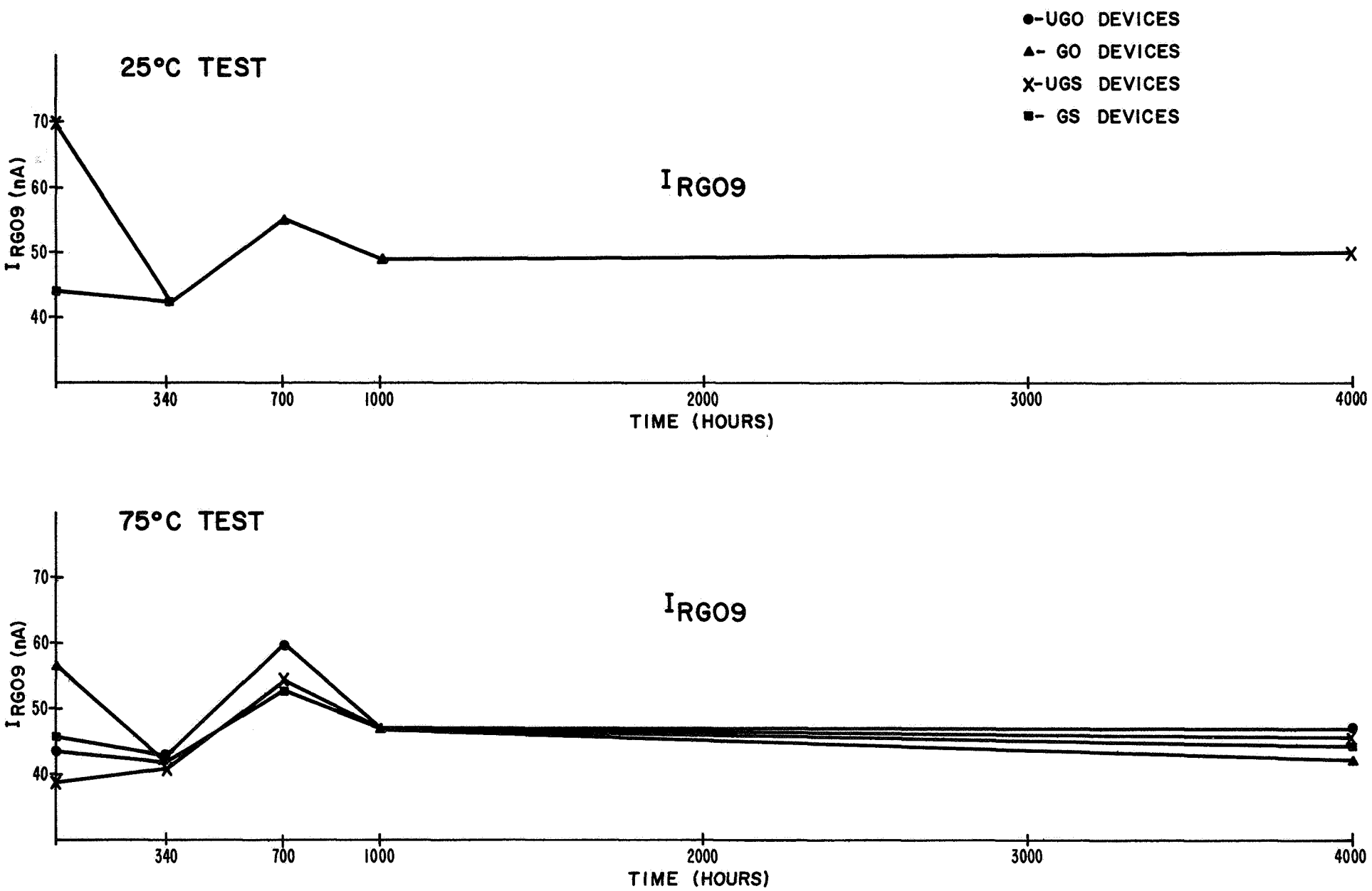


Figure 14. I_{RG09} as a function of test duration.

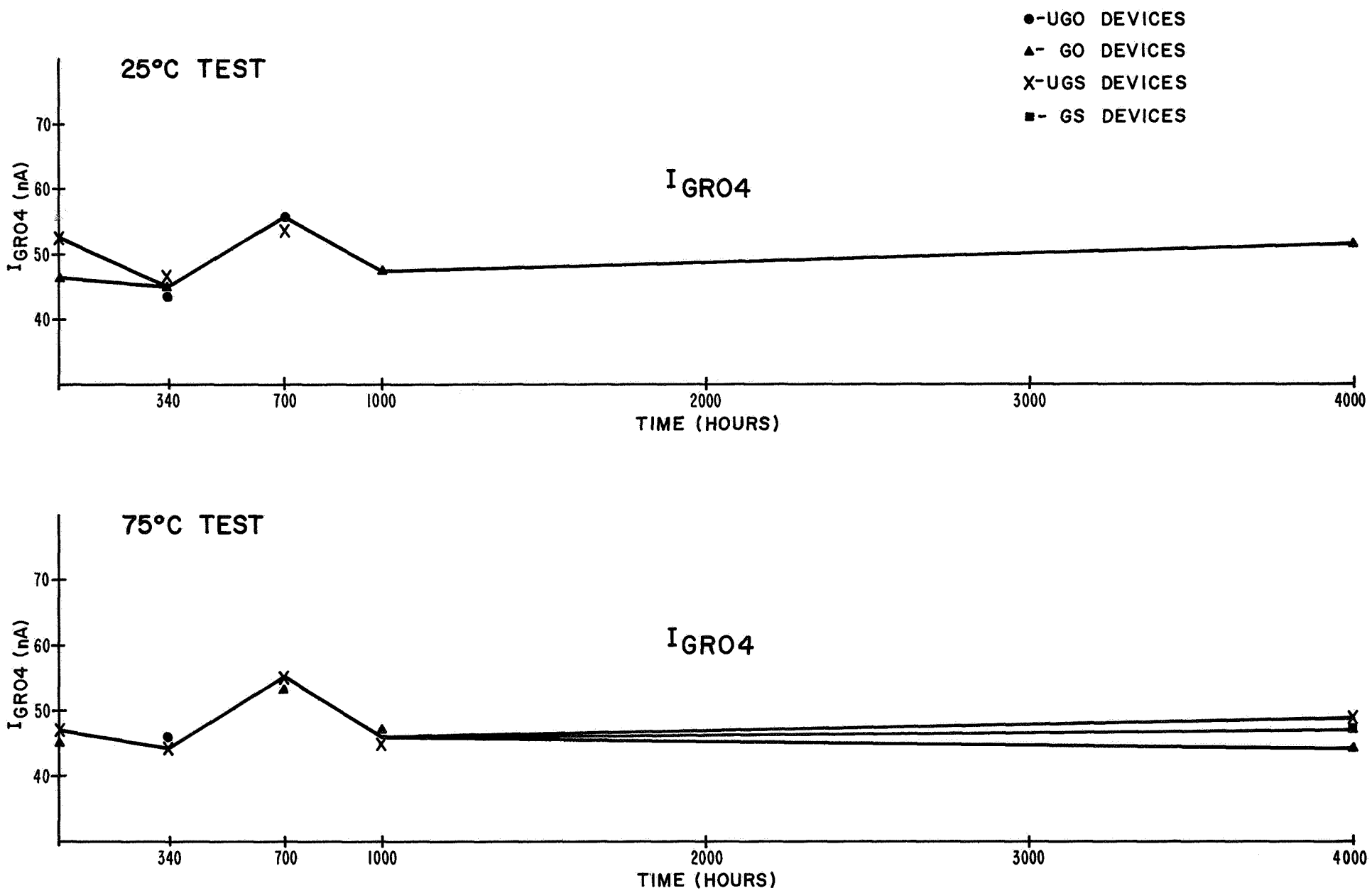


Figure 15. I_{GRO4} as a function of test duration.

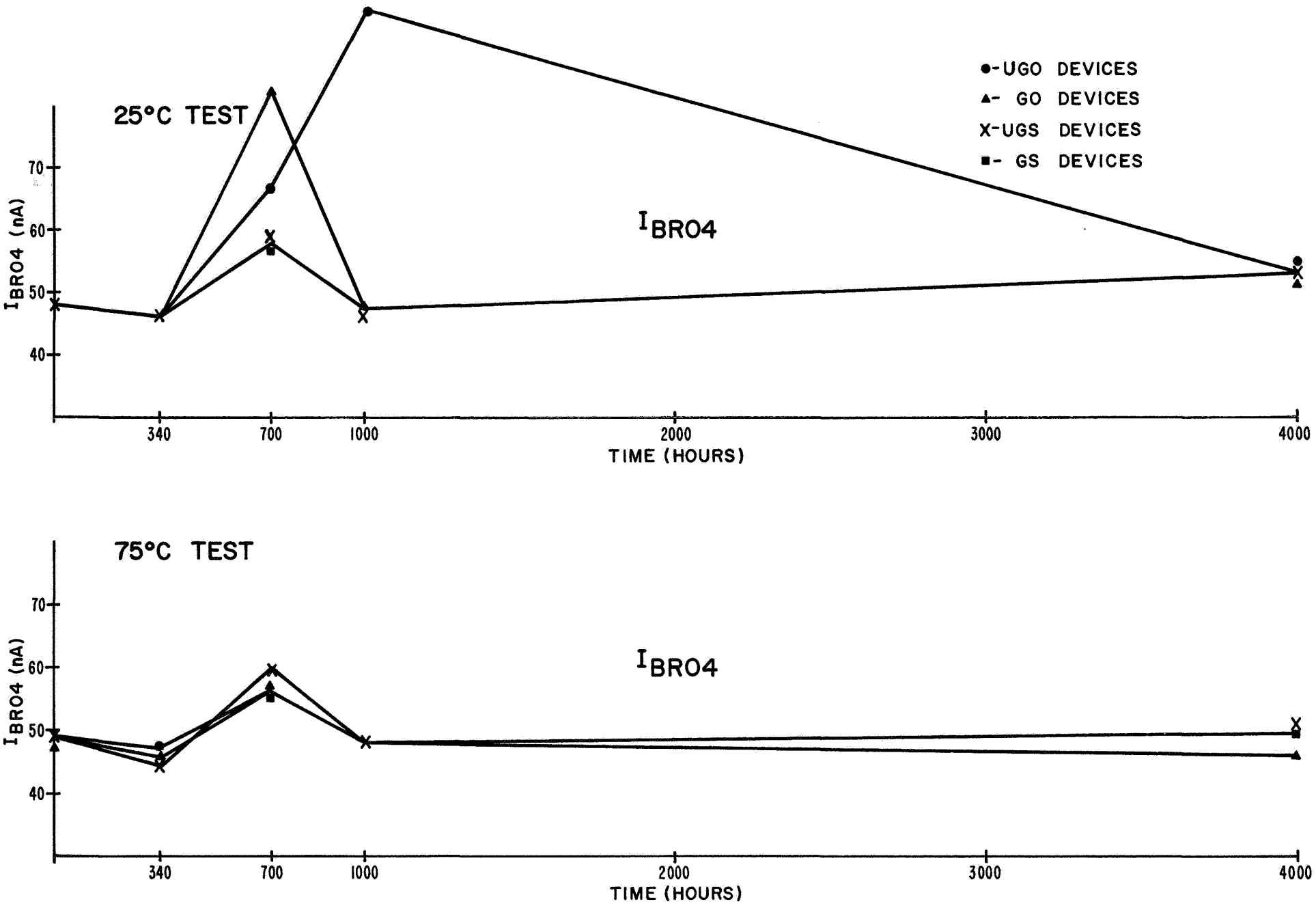


Figure 16. I_{BRO4} as a function of test duration.

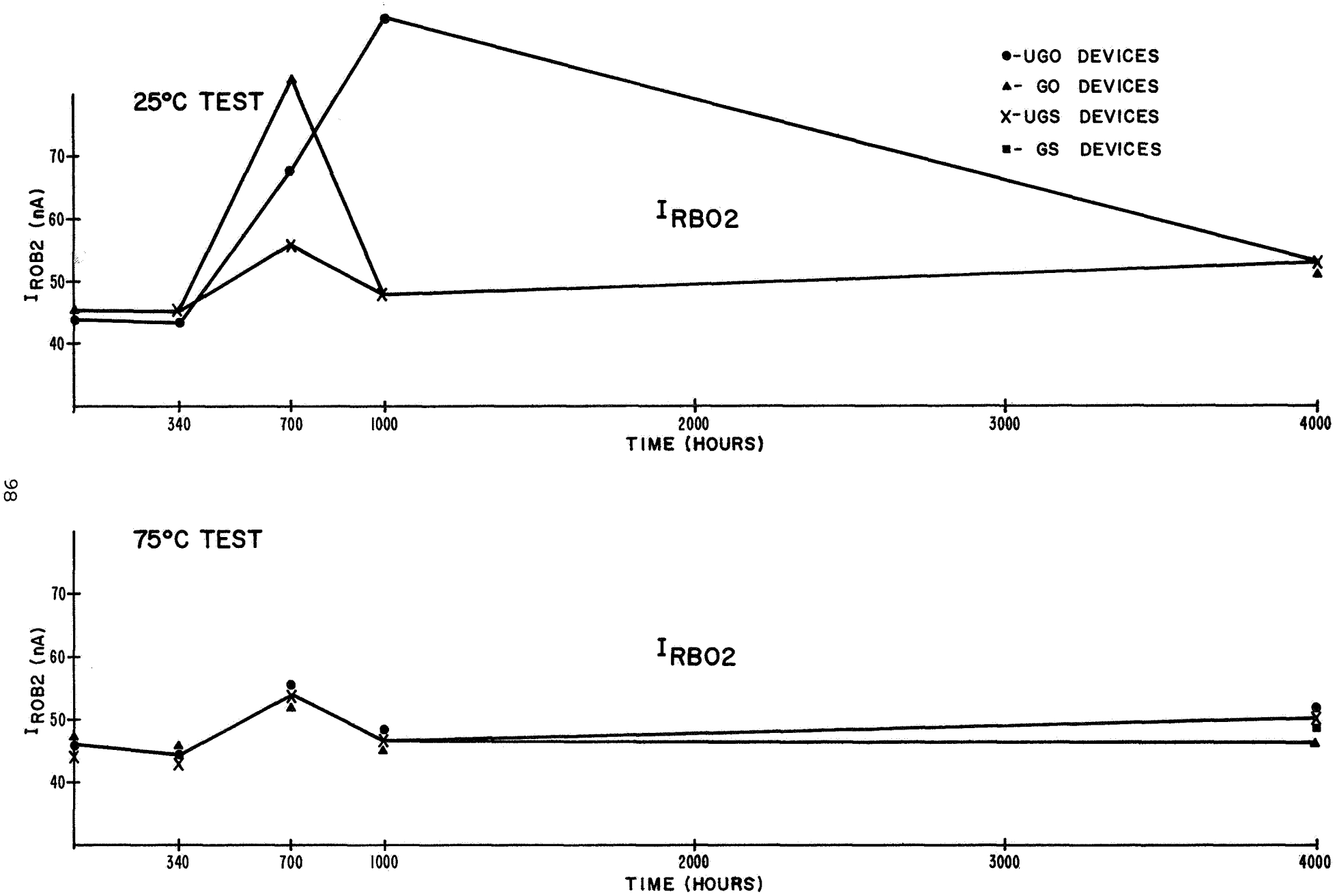


Figure 17. I_{RBO2} as a function of test duration.

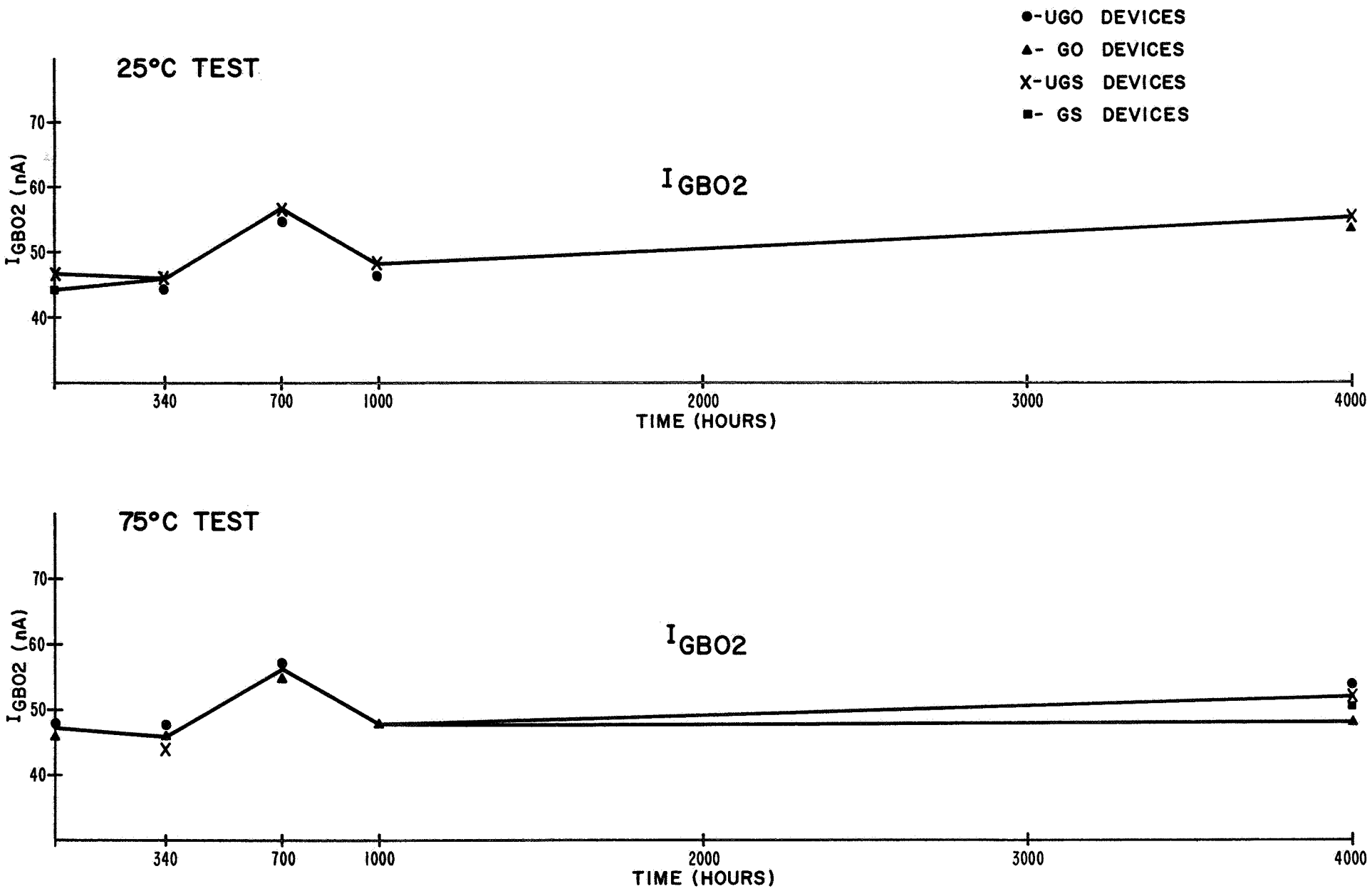


Figure 18. I_{GBO2} as a function of test duration.

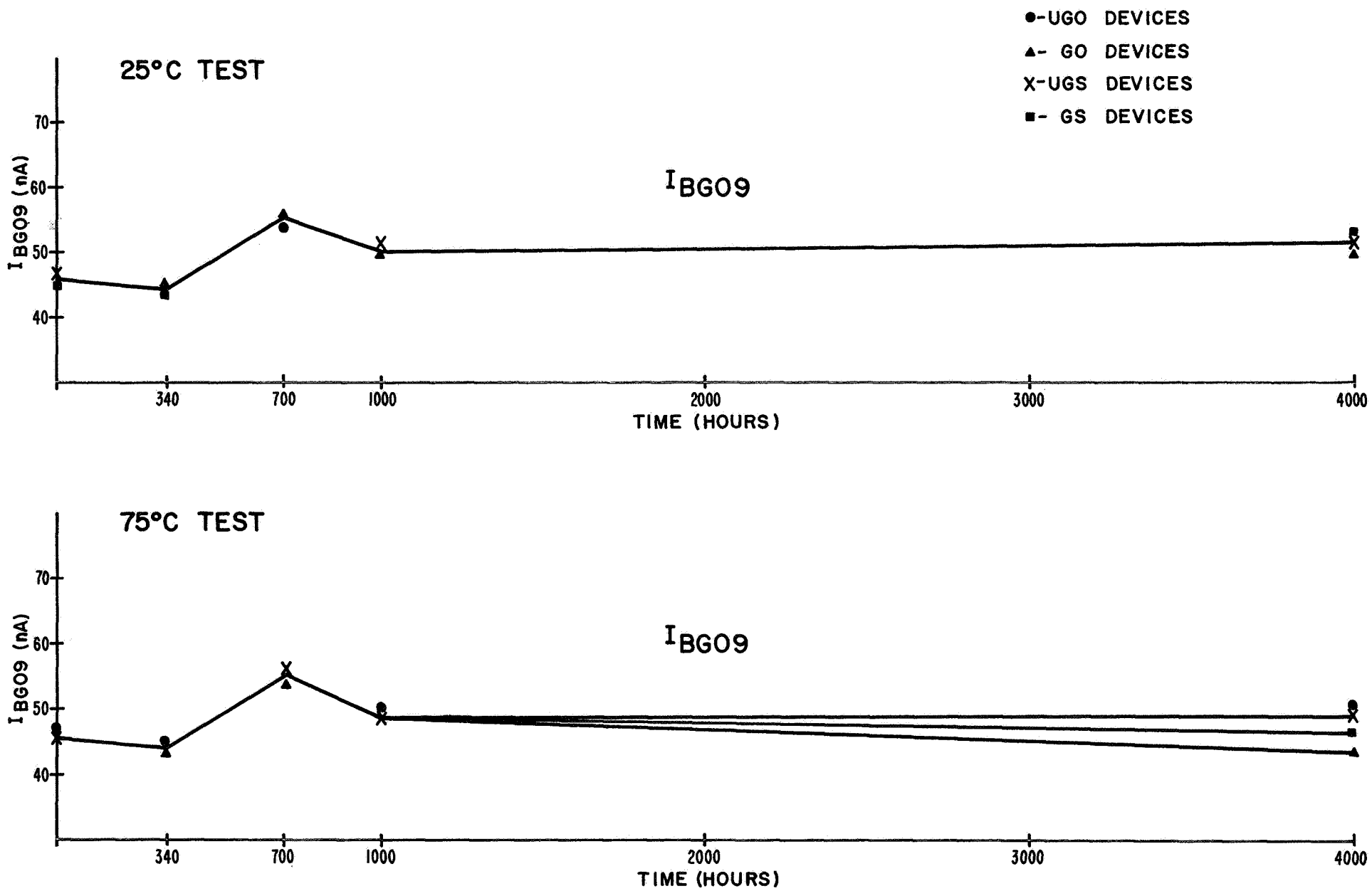


Figure 19. I_{BGO9} as a function of test duration.

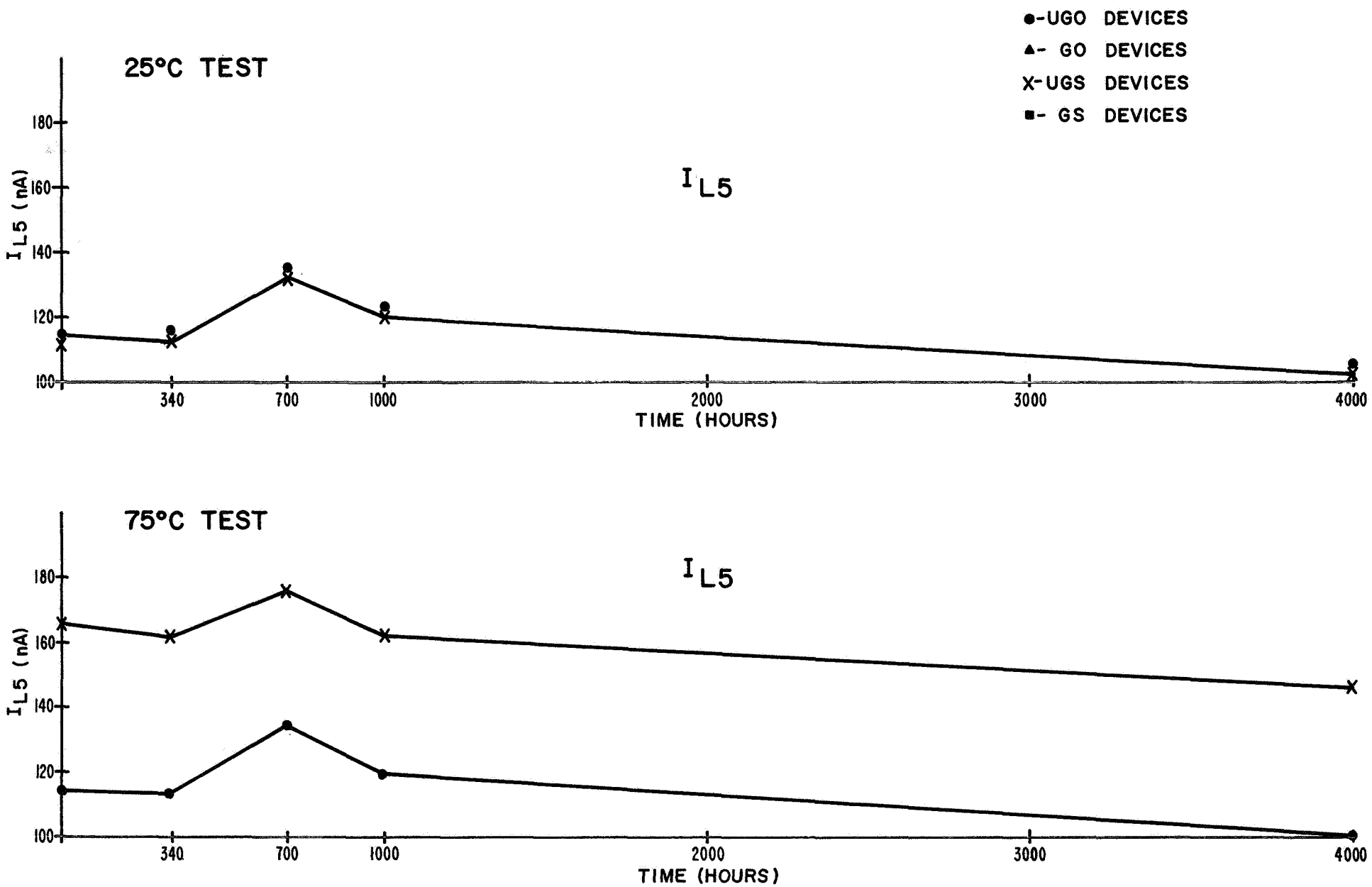


Figure 20. I_{L5} as a function of test duration.

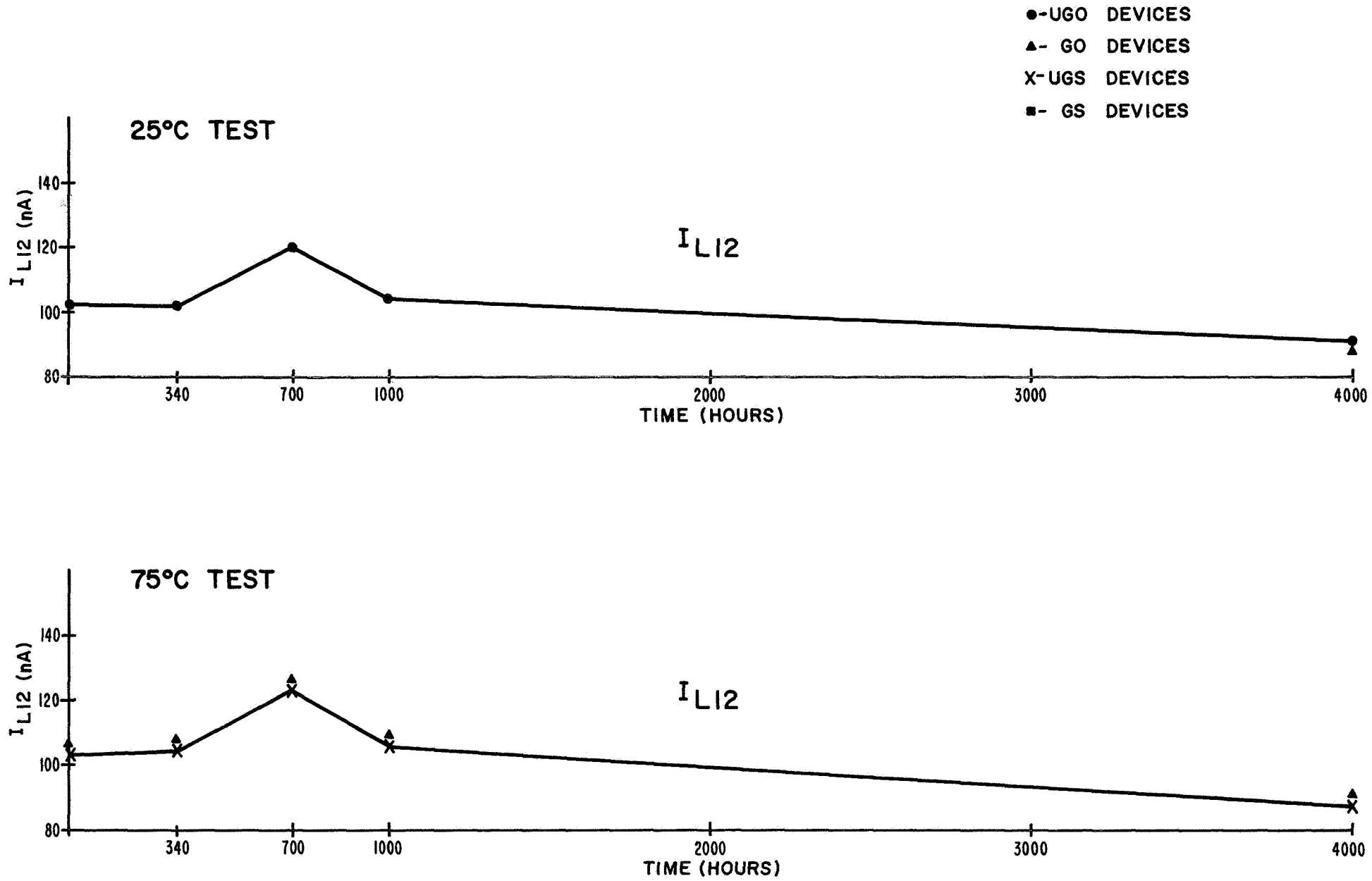


Figure 21. I_{L12} as a function of test duration.

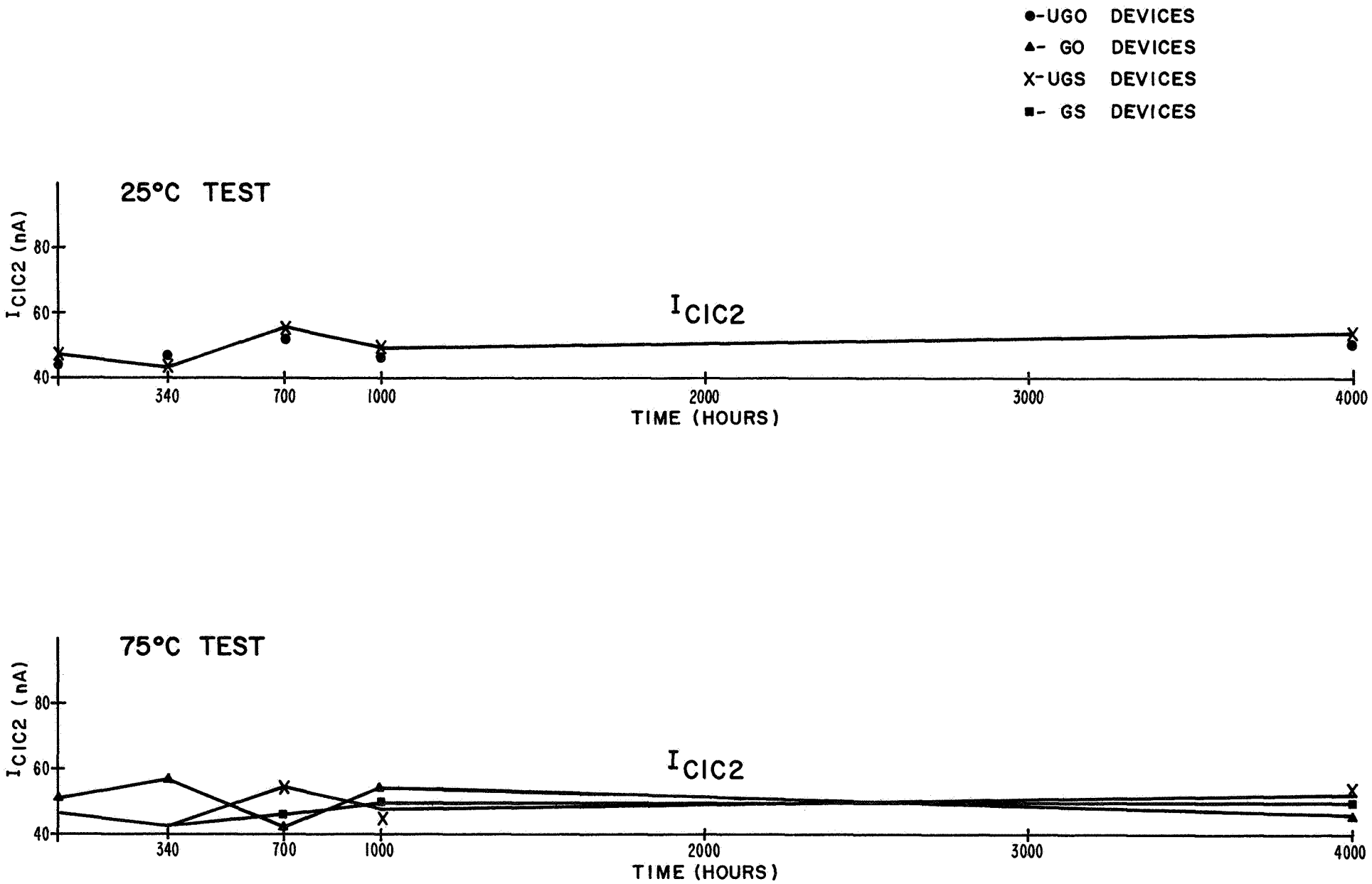


Figure 22. I_{C1C2} as a function of test duration.

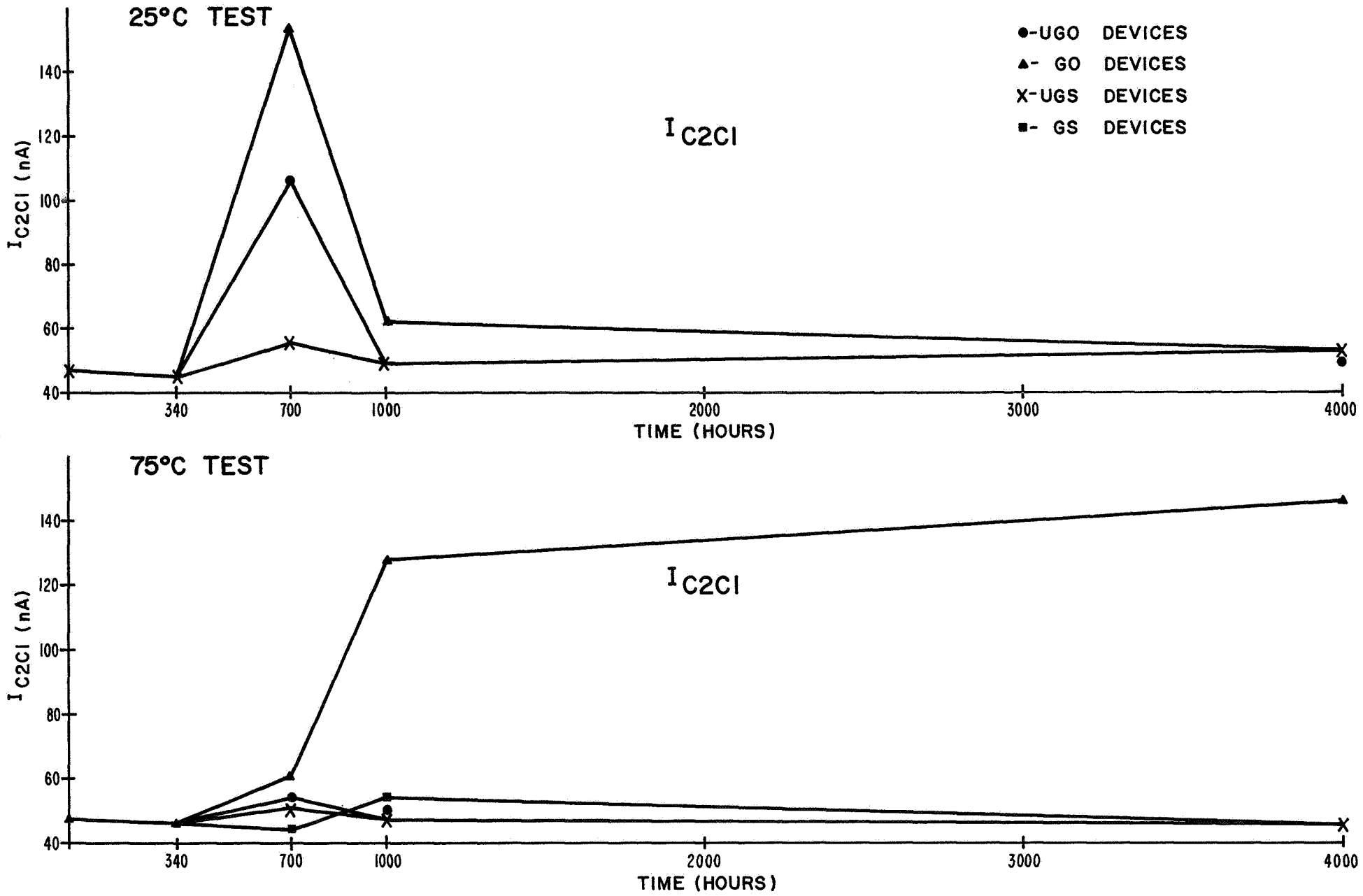


Figure 23. I_{C2C1} as a function of test duration.

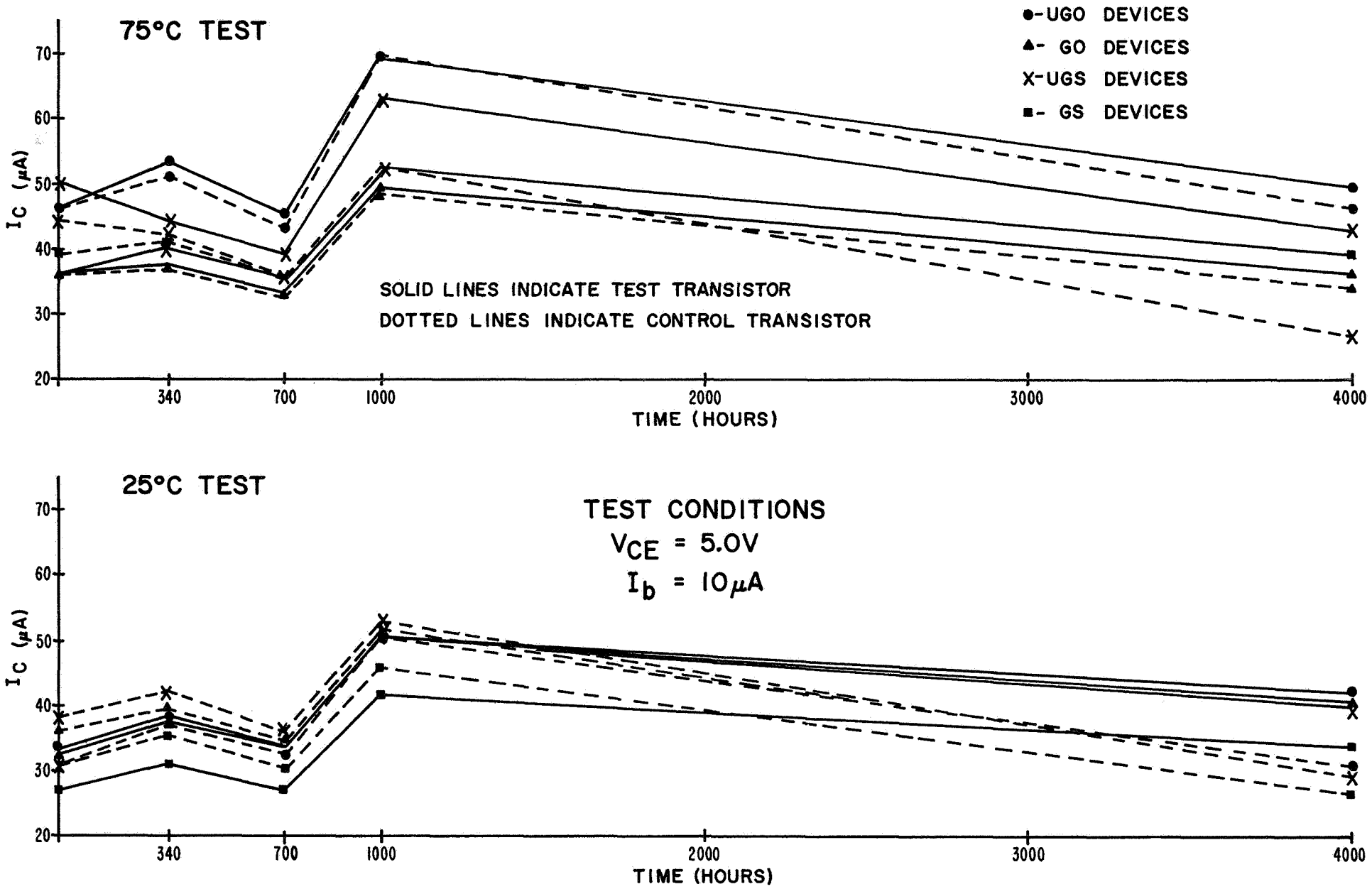


Figure 24. B_{TATL} and B_{TACL} as functions of test duration.

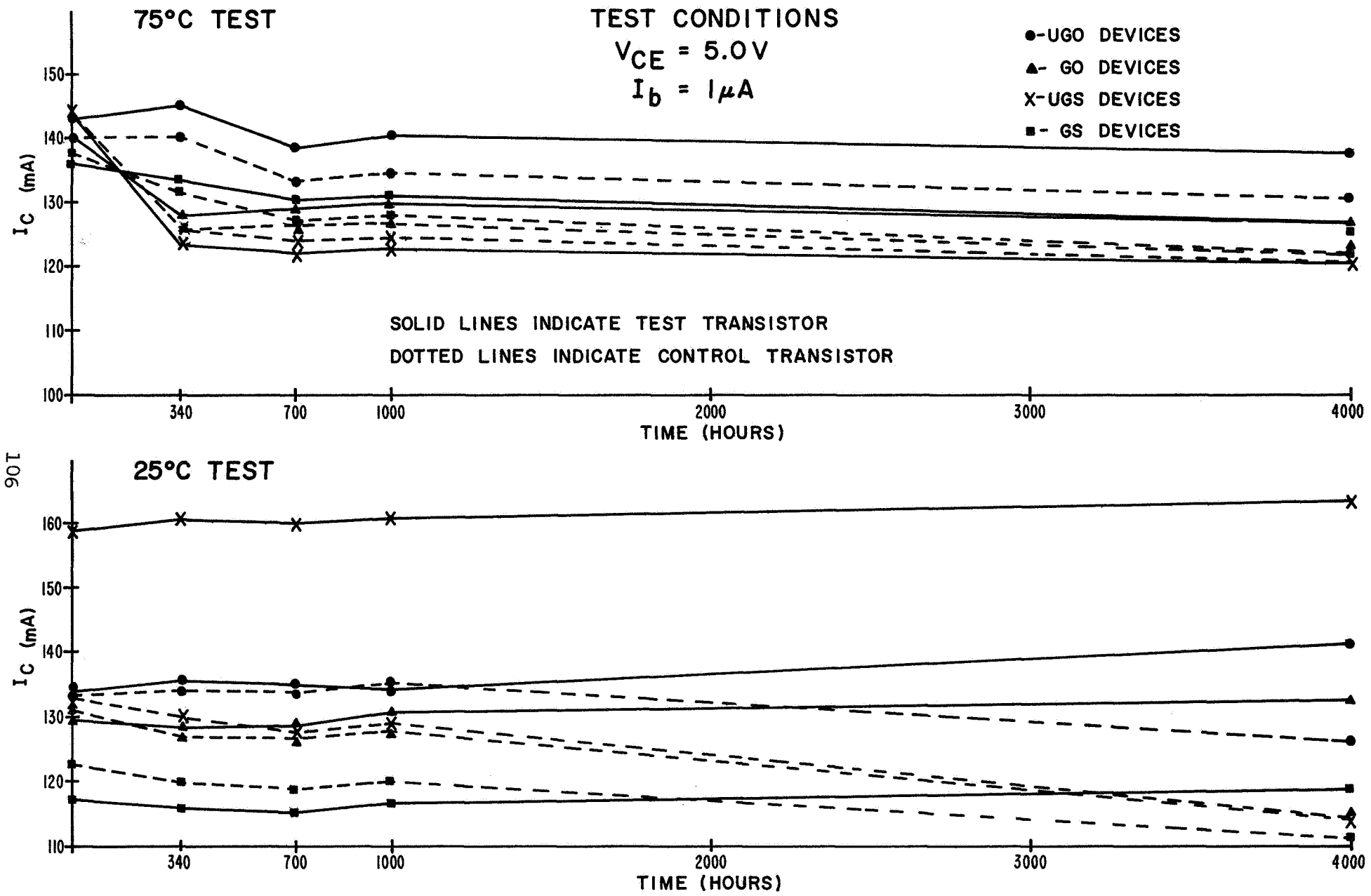


Figure 25. B_{TATH} and B_{TACH} as functions of test duration.

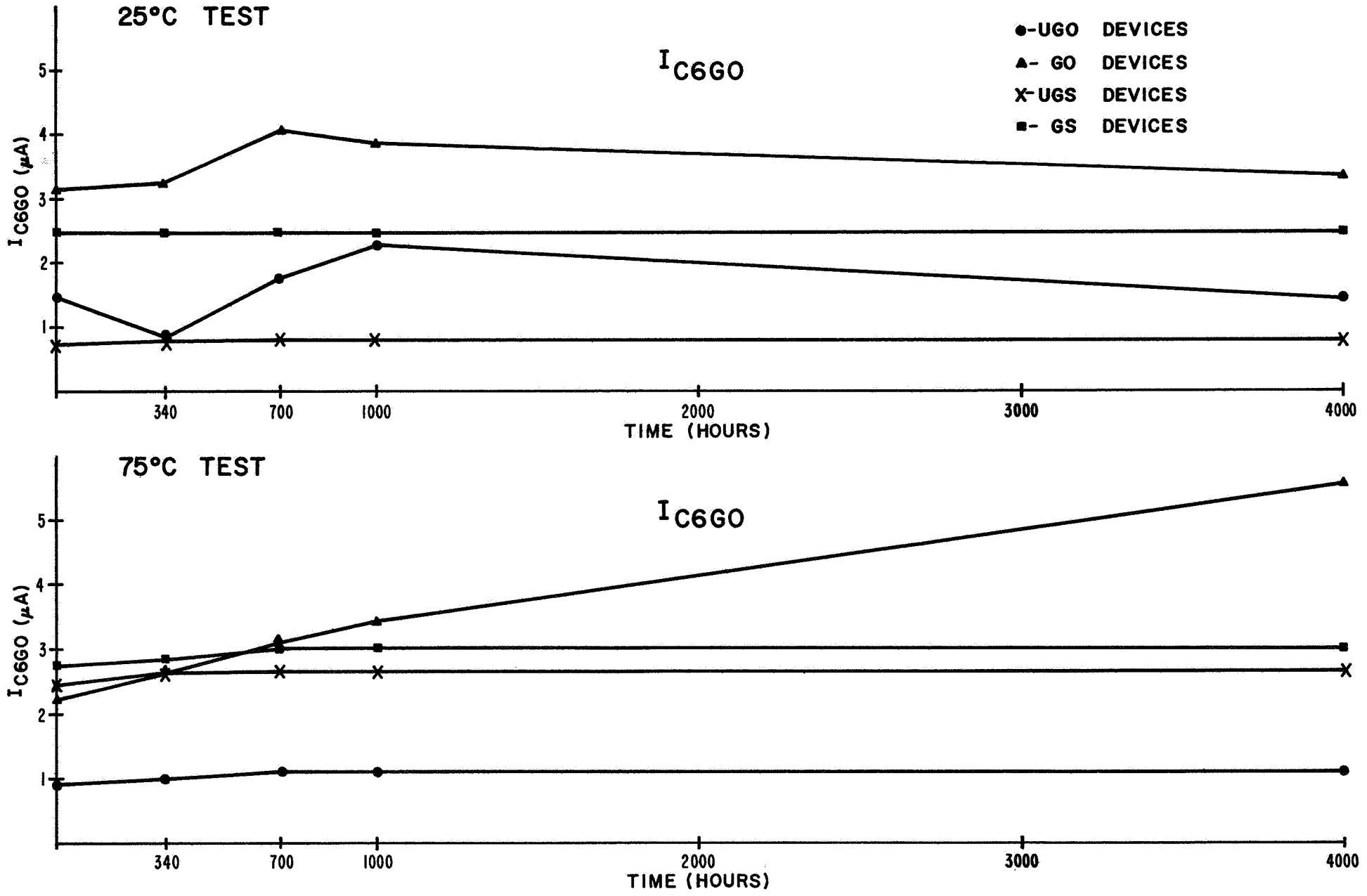


Figure 26. I_{C6GO} as a function of test duration.

7.6 FAILURE ANALYSIS

7.6.1 General

All devices from the second group were removed from test when the measured parameters exceeded the limits established in Table IX. Of these devices, an analysis was performed on all sealed devices and on the unsealed devices that failed during reverse bias life testing. The unsealed devices which failed during the environmental sequence were not subjected to analysis because it would be too difficult to determine whether the cause of failure was the screening sequence or if the device was damaged because insufficient protection of the chip and internal whisker wires resulted in mechanical damage or high leakage currents from contamination on the surface of the chip.

7.6.2 Failure Analysis Procedure

The general procedure utilized in the analysis of the devices which failed to meet the electrical specification imposed was:

a. To verify the failed parameter measurements on the automatic test equipment that was used for the electrical measurements at the specified reading periods in the life and environmental test sequence.

b. To observe the failed parameter characteristics on a curve tracer.

c. To open the package and obtain visual verification of the failure mechanisms when possible.

7.6.3 Predominant Failure Modes and Mechanisms

The failure modes and mechanisms observed on the devices tested under this contract are summarized in Table XIII and the predominant failure modes and mechanisms are discussed in the following paragraphs.

7.6.3.1 Predominant Failure Modes and Mechanisms Observed on Devices during Room Temperature Storage.

The original group of devices, after being subjected to the environmental test sequence and a 18-hour 300°C bake-out subsequent to the discontinued life test, was measured electrically and held at room temperature storage for about 6 weeks. A second set of electrical readings was then made prior to reverse bias testing and failures were discovered. These failures were predominantly caused by high leakage between the "p" type resistor through the "n" type substrate to the "p" type isolation region, and occurred most frequently when the resistor was reverse biased during the electrical test (Test L_{RG09}). The cause believed responsible is inversion of the "n" type bathtub.

It should be noted, however, that the extent of I_{RG09} degradation was apparently more severe on the unglassed sealed devices than on the glassed sealed devices. The glassed sealed devices recovered during retesting but the unglassed sealed device was inverted to the extent that I_{RG09} & I_{GR04} were resistive.

7.6.3.2 Predominant Failure Modes and Mechanisms on Second Group of Devices During the Environmental Screening.

The most predominant failure mode observed on devices subjected to the environmental screens was chip and bond failures. The purpose of the screen was to remove devices of poor mechanical

TABLE XIII

FAILURE MODE SUMMARY

OLD DEVICES:

Device	Type	Failed At	Inversion	Bonds	Plate Shorting	Other	Comments
158	UGS	Pre-life	I_{RG09} I_{GR04}				Baked 96 hrs, 200°C, No change. Curve tracer shows 9-4; 4-2; 9-2, as Resistive. Failure mechanism is inversion.
589	GS	"				BTACH	Peculiar BTACH characteristics Pinhole-collector metal to redoped isolation.
778	GS	340 hrs 75°C RB	I_{RG09} I_{RB02} I_{RC01}				Inversion of "n" type bathtub. Device partially recovered during room temperature storage.
780	GS	694 hrs 75°C RB				I_{DSL}	No apparent cause for failure.
784	GS	"			I_{L12}		Device has many pinhole-failure mechanism is probably pinhole under Pin 12 metal to bathtub 1.
788	GS	PRE LIFE	I_{RG09}				Device passes spec at retest but diode is creepy - Failure mechanism - resistor-isolation channel.
877	GS	"	I_{RG09}				Parameter good at retest but curve tracer shows 9-4; 4-2; & 9-2 Just in spec - mech. is inversion.
128	GO*	340 hours 25°C RB				I_{EBOT}	Device recovered and was returned to test - test error.
151	UGS	"	I_{C2C1}				Inversion of isolation region to form "n" to "n" channel.
111	UGO	694 hrs. 25°C RB	I_{C2C1}				Device recovered at room temperature storage - mech inversion of isolation region to form "n" to "n" channel.
109	UGO	1000 hrs. 25°C RB	I_{C2C1}				Device recovered at room temp. storage - mech is inversion of isolation region to form "n" to "n" channel.

TABLE XIII

FAILURE MODE SUMMARY

OLD DEVICES (con'd)

Device	Type	Failed At	Inversion	Bonds	Plate Shorting	Other	Comments
526	GO	340 hrs. 75°C RB	I_{C2C1}				Device recovered at room temp. storage - mech is inversion of isolation region to form "n" to "n" channel.
529	GO	"	I_{C2C1}				" " " "
536	GO	"	I_{C2C1}				" " " "
544	GO	"	I_{C2C1}				" " " "
548	GO	"	I_{C2C1}				" " " "
558	UGS	"			I_{L5} I_{L12}		No visible evidence of shorting. Application of 50V between 12 & 5 cured condition - mechanism was probably foreign material.
517	UGO	694 hrs. 75° RB	I_{BR04} I_{RB02}				Device showed slight improvement in characteristics during room temperature storage. Mechanism is inversion of "n" bathtub to cause channel between Resistor & base regions.
531	GO	4000 hrs. 75°C RB	I_{C2C1}				Device recovered at room temperature storage. Mechanism is inversion of isolation region to form "n" to "n" channel.

TABLE XIII

FAILURE MODE SUMMARY

NEW DEVICES

Device	Type	Failed At	Inversion	Bonds	Plate Shorting	Other	Comments
50	FPS	Post Screen		Wire & Chip			Chip dismounted + open emitter, base & collector wires on transistor.
51	FPS	"		Wire			Open Collector wire on control transistor.
78	GS	"	I_{GR04}	Wire			I_{GR04} recovered during room temp. storage - Base lead is broken near center of wire - collector lead open at package bond.
79	GS	"			I_{L12}		Pinhold to isolation region.
81	GS	"		Wire & Chip			Unbonded chip and open leads to pin 12, isolation & collectors of both transistors.
87	GS	"	I_{RB02}				Failed for both I_{RB02} & I_{BR04} during recheck - both parameters recovered during room temperature storage - mech. is base resistor channel.
253	UGS	"	I_{RG09} I_{GR04}				Tests good after 96 hour 200°C bake. Mechanism was resistor isolation channel.
259	UGS	"	I_{RG09} I_{GR04} I_{BR04} I_{RB02} I_{GB02} I_{BG09}				I_{RG09} & I_{GR04} show as resistive after 96 hour 200°C bake - all other parameters recovered. Failure mechanism is inversion.
278	GS	"	I_{RG09}				Parameter just within spec at retest after room temperature storage. Failure mechanism is resistor isolation channel.
284	GS	"		Wire			Open base on control transistor at chip land.

TABLE XIII

FAILURE MODE SUMMARY

NEW DEVICES (con'd.)

Device	Type	Failed At	Inversion	Bonds	Plate Shorting	Other	Comments
289	GS	Post Screen	I_{RG09}				Device just within spec. at retest after room temperature storage. Failure mechanism is resistor isolation channel.
290	GS	"		Wire & Chip			Chip dismounted - Pin 2, & base of test transistor open at chip. Pin 4 & collector of test transistor open at package bond.
293	GS	"			I_{L12}		Pinhole - Pin 12 metal to isolation region.
482	GS	"					Failed I_{L5} but tests good on recheck - test error or included foreign particle not detected during visual examination.
485	GS	"	I_{RG09} I_{GR04}				Parameters remain out of spec after 96 hour, 200°C bake. Mechanism is resistor to isolation channel.
651	UGS	"		Wire & Chip			Chip dismounted - many broken internal wires some of which were shorted together.
654	UGS	"		"			Chip dismounted - the chip was lost during opening but curve tracer test prior to opening indicated wire opens.
657	UGS	"		"			Chip dismounted - internal leads open.
658	UGS	"		"			Chip dismounted. Internal open leads.
659	UGS	"	I_{RG09} I_{GR04} I_{BR04} I_{RB02} I_{BG09} I_{GB02} I_{C1C2}				Device tests OK after 96 hr. 200°C bake & subsequent room temperature storage - Failure mechanism is inversion.

TABLE XIII

FAILURE MODE SUMMARY

NEW DEVICES (con'd.)

Device	Type	Failed At	Inversion	Bonds	Plate Shorting	Other	Comments
660	UGS	Post Screen	I_{RG09} I_{RB02} I_{GR04} I_{BR04}	Chip	I_{L5} I_{L12}	BTACH BTACL	Parameter failure due to internal shorting caused by dismounted chip.
676	GS	"		Wire & Chip			Parameter failures due to dismounted chip & open internal whisker wires.
677	GS	"		"	I_{L12}		Parameter failures due to dismounted chip, open internal wires & pinhole under Pin 12 metal.
681	GS	"		"			Parameter failures due to dismounted chip & open internal wires.
682	GS	"	I_{GR04} I_{GB02} I_{CG01} I_{C1C2}	"	I_{L5}		Parameter failures due to dismounted chip, pinhole under Pin 5 metal to n+ bucket & internal shorting of open wires.
952	UGS	"	I_{RG04} I_{GR04} I_{BR04} I_{RB02} I_{GB02} I_{BG09} I_{C1C2}				Device tests good after 96 hour, 200°C bake & room temperature storage - Failure mechanism was inversion.
956	UGS	"	I_{RG09}				Device tests good after room temperature storage. Failure mechanism was inversion.
959	UGS			Wire & Chip			Parameter failures due to dismounted chip & open internal leads.
961	UGS	"	I_{RG09} I_{GR04}				I_{RG09} & I_{GR04} are resistive after 96 hour, 200°C bake and room temperature storage - Failure mode is inversion.

TABLE XIII

FAILURE MODE SUMMARY

NEW DEVICES (con'd.)

Device	Type	Failed At	Inversion	Bonds	Plate Shorting	Other	Comments
603	UGO	694 hrs. 25°C RB	I_{RG09} I_{GR04} I_{BR04} I_{RB02} I_{GB02} I_{BG09} I_{C2C2}				I_{RG09} & I_{GR04} is resistive, I_{C2C2} shows high leakage - Failure mechanism is inversion.
629	GO	"	I_{BR04}	Wire	I_{L5} I_{L12}		Failure due to open internal bond.
908	UGO	"	I_{RG09} I_{GR04}				I_{RG09} recovered with Room Temperature storage. I_{GR04} exhibits creepy diode Failure mode was inversion.
254	UGS	340 hrs. 25°C RB	I_{BR04} I_{BG09}			I_{CB01} B_{TATL}	Device exhibits good B_{TATL}, but creepy diodes on retest. Failure mechanism was inversion.
608	UGO	340 Hrs 75°C RB		NO FAILURE			Failed BTACL & BTACH but retested good - test error.
638	GO	"		NO FAILURE			Failed BTATI but retests good - test error.
685	GS	694 Hrs 75°C RB	I_{C2C1}				Device retested good after room temperature storage. Failure mechanism was inversion.
235	GO	694 hrs. 75°C RB	I_{G2C1}				Device retested good after room temperature storage - Failure mechanism was inversion.
241	GO	"	I_{C2C1}				Device retested good after room temperature storage. Failure mechanism was inversion.
403	FPO	694 Hrs 25°C RB					Failed for I_{L11} but retested good.
913	UGO	694 Hrs 75°C RB	I_{BR04} I_{RB02}				Device recovered at retest but I_{RB02} was just within spec limit. Failure mechanism was inversion.
437 439	GO GO	4000 Hrs 75°C RB				All parameters associated with Pins 1 and 2.	Internal short between pins 1 and 2 resulted in excessive current flow during test melting aluminum metalization.

construction, so these failures were not unexpected. The second most predominant failure mode was high resistor-to-isolation leakage. Here a significantly larger percentage of the unglassed sealed devices (when compared to the glassed sealed devices) failed. As was previously described, the resistor-to-isolation leakage is believed to be caused by inversion of the "n" type bathtub. Again, the degree of inversion in the unglassed sealed devices is apparently worse than the degree observed in the glassed sealed devices because some of the unglassed devices were inverted to the extent that the I_{RG09} measurement was resistive. The following table depicts the extent of inversion and recovery of devices during the environmental screening tests.

TABLE XIV

INVERSION AND RECOVERY OF GLASSED AND UNGLASSED DEVICES

	Glassed Sealed Devices	Unglassed Sealed Devices
Sample	67	38
Inverted	5	6
Recovered	4	4
Resistive	-	2

7.6.3.3 Predominant Failure Modes and Mechanisms Observed on Devices Subjected to 25°C Reverse Bias Testing.

The predominant failure modes exhibited by the test vehicles during reverse bias operation at 25°C were high collector-to-collector leakage and high resistor-to-isolation leakage. Both of these failure modes are believed to be due to inversion. The devices exhibiting the high

collector-to-collector leakage, I_{C2C1}, all recovered during room temperature storage, and the devices exhibiting high resistor-to-isolation leakage showed various degrees of recovery during room temperature storage.

7.6.3.4 Proposed Inversion Mechanisms

a. Inversion of Isolation Region to Form Collector to Collector Channel.

The mechanism proposed for the high I_{C2C1} leakage observed is the inversion of the "p" type isolation during the reverse bias life test, in much the same manner as is utilized to cause conduction in an MOS structure. A cross section of the device through the pin 5 metal over the isolation region between collector bucket 1 and collector bucket 2 is shown below together with the biases applied during the life test.

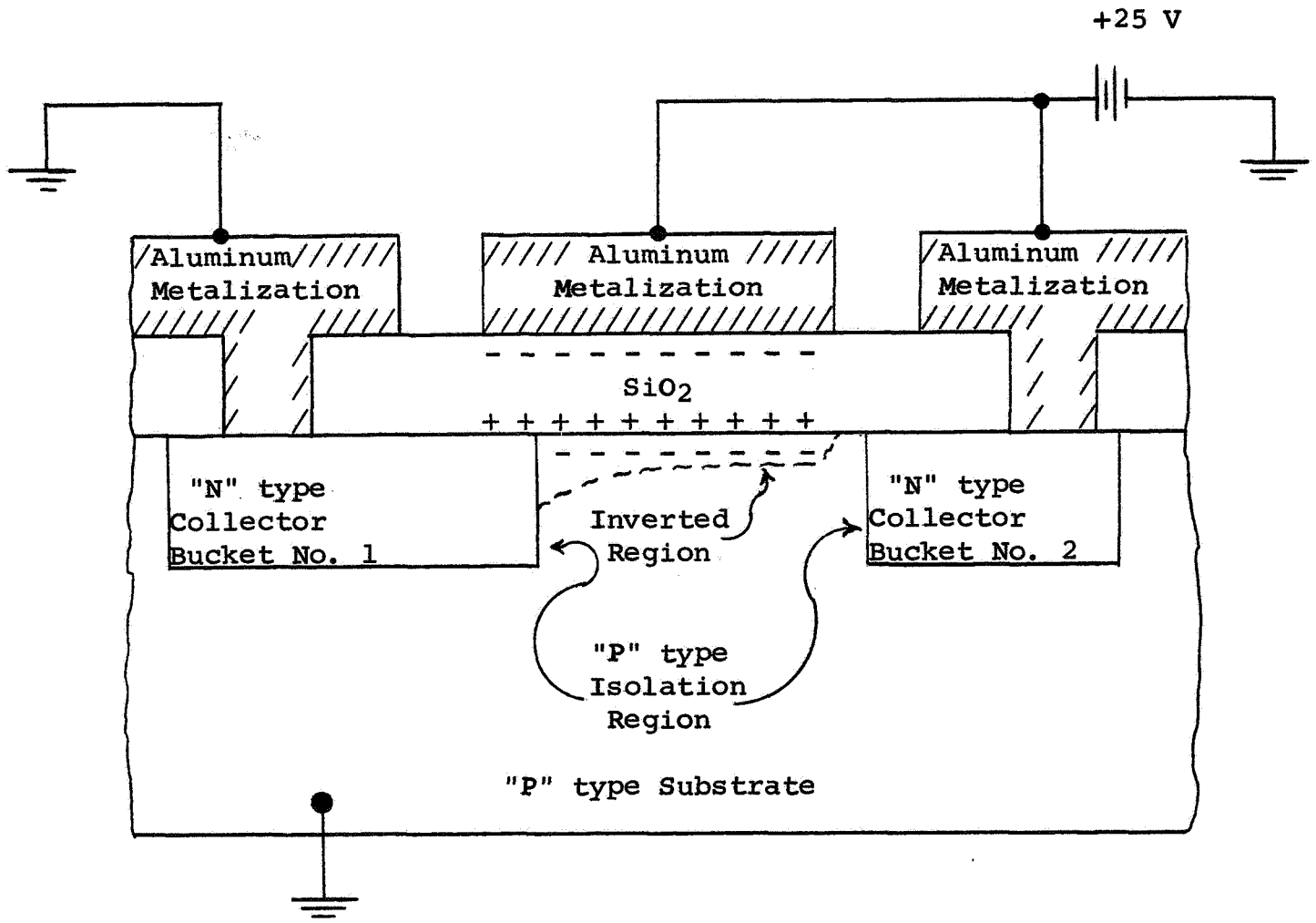


Figure 27. Inversion of "p" type isolation during reverse bias life test.

During the life test, the positive potential applied to pin 5 (and to the associated metalization which crosses the isolation region between the collector buckets 1 & 2) drifts positively charged ions in the SiO_2 toward the Si-SiO_2 interface near the isolation region. This positive charge attracts negatively charged particles (electrons) from the Si toward the SiO_2 interface. The accumulation of positive charges in the oxide above collector bucket #2 is inhibited by the positive potential applied to the bucket. During electrical test, application of a positive potential to pin 6 causes the inverted region to reach into collector bucket #2 and cause high leakage, but applications of the positive potential to bucket #1 (Pin 1, I_{C2C1}) will not cause the channel to reach through the I_{C2C1} will exhibit leakages sufficiently low to pass the electrical specification. Upon removal of the life test bias conditions, the charges gradually redistribute themselves until the collector-to-collector leakage returns to normal levels.

b. Inversion of "n" Type Bathtub to Form Channels.

The failure mode proposed for high resistor-to-isolation leakage is the inversion of the "n" type bathtub. The mechanism by which this inversion occurs is complex in that it does <u>not</u> appear to be related to the application of potentials to the device, since the failure mode was observed not only on reverse bias life test devices but also on devices which had been subjected to mechanical and thermal environmental tests. The mechanism is apparently related to the periphery of n-p junction because the parameter that failed most frequently was I_{RG09}. This is the leakage across the reverse biased resistor junction (located in the same bathtub as the test transistor) to the isolation region of the device.

7.6.3.5 Frequency of 25°C Reverse Bias Testing Failures

The extent to which I_{C1C2} and I_{RG09} failures occurred during the 25°C Reverse Bias testing are summarized below.

TABLE XV

FREQUENCY OF 25°C REVERVE BIAS TESTING FAILURES

	Original Devices				New Devices				New & Orig.Comb.				Comb-ined
	UGO	GO	UGS	GS	UGO	GO	UGS	GS	UGO	GO	UGS	GS	
Sample	8	9	7	6	12	23	13	24	20	32	20	30	102
I_{C1C2} Failures	2	0	1	0	1*	0	0	0	3*	0	1	0	4*
Resistor to Isolation leakage failures	0	0	0	0	2*	0	0	0	2*	0	0	0	2*
Other Failures	0	0	0	0	0	1	0	0	0	1	0	0	2
Total Failures	2	0	1	0	2	1	0	0	5*	1	2	0	8*

* One device failed for both isolation to resistor and collector-to-collector leakage.

The significance of the data from TableXV is that it indicates glassing of unsealed devices has reduced the number of failures attributed to inversion, although it also indicates that hermetic packaging is just as effective for this purpose.

7.6.3.6 Predominant Failure Modes Observed During 75°C Reverse Bias Testing

The predominant failure modes exhibited by the test vehicles subjected to reverse bias operation at 75°C were high collector-to-collector leakage and high resistor to isolation leakage. These failures are believed due to inversion caused by the same mechanism described in sub paragraph 7.6.3.4.

The extent to which collector-to-collector and resistor-to-isolation leakage were responsible for failure during this testing is indicated in the following Table:

TABLE XVI

PREDOMINANT FAILURE MODES IN 75°C REVERSE BIAS TESTING

	Original Devices				New Devices				New & Orig.Comb.				All Combined
	UGO	GO	UGS	GS	UGO	GO	UGS	GS	UGO	GO	UGS	GS	
Sample	3	12	2	12	12	26	10	26	15	38	12	38	103
Collector-to-Collector Leakage Current	0	6	0	0	0	2	0	1	0	8	0	1	9
Resistor to Isolation Leakage Failures	1	0	0	0	1	0	0	0	2	0	0	0	2
Other	0	0	1	3	0	2	0	0	0	2	1	3	6
Total Failures	1	6	1	3	1	4	0	1	2	10	1	4	17

The significance attached to the data of this Table again is that the sealed devices showed a lower incidence of failure than the unsealed devices, for inversion type failures. The data also shows that the glassed open devices exhibited a considerable number of failures for collector-to-collector leakage.

7.7 CONCLUSIONS

The conclusions that can be drawn from the test data obtained during the course of this contract are indicated in the following paragraphs.

7.7.1 Effectiveness of Screens

The in-process screens applied to these devices were quite effective in removing devices prone to both mechanical and thermal failures, as demonstrated by the fact that no thermal and only one mechanical failure was incurred during the life testing of the devices which survived the mechanical screens. The screens which removed most of the potential failures were the 6000 "G" mechanical shock screen and the 20,000 "G" constant acceleration screen. The constant acceleration screen would appear to have been a more effective procedure for the removal of mechanically weak devices because additional failures were obtained during this test after the devices had been subjected to and survived the mechanical shock test.

The thermal shock test also appears to be a more effective screen than the temperature cycling screen, because additional failures were incurred after the devices had been subjected to and survived the temperature cycling testing.

Care should be taken, however, before generalizing that the apparently more effective screens are in fact actually more effective. It is entirely possible that the failures observed during constant acceleration testing were actually initiated during the mechanical shock testing and that the failures incurred during the thermal shock testing were initiated during the temperature cycling testing. As previously stated, the in-process screens were effective in removing potential mechanical and thermal failures. The screening sequence could possibly be improved by increasing the 6000 "G" mechanical shock screen "G" level to 20,000 - 25,000 "G", but this change would require evaluation.

The 200°C stabilization bake was not effective in removing devices which subsequently showed parameter changes attributed to inversion. This does not mean, however, that the stabilization bake screen should be removed from the sequence. The 200°C stabilization bake has the effect of reducing the internal wire bond strength and thereby aiding in the elimination of devices with marginal bond strength through subsequent mechanical testing. The addition of a reverse bias screen would have eliminated most of the I_{C2C1} failures that were observed during the reverse bias life test, and consideration of such a screen should be made when procuring high reliability parts. The life test data indicates that the I_{C2C1} failures generally occurred earlier during the 75°C test than they occurred during the 25° C test. From this one could infer the possibility of trading increased life test temperature for decreased reverse bias life test duration. The effectiveness of high temperature short duration reverse bias testing would need to be verified, however, for each individual device type in a particular circuit.

The 200°C stabilization bake did not screen devices which subsequently failed for high resistor-to-isolation leakage. Several devices failed for this type of defect during the reverse bias life test, but these failures occurred primarily during the 25°C test rather than the 75°C test, and a considerable number of devices failed for this parameter during the environmental screens. It appears in this case that high temperature testing masks the high resistor-to-isolation leakage failure mode.

Based on the above, it appears that the most effective reverse bias screen for inversion type of failures must be determined by consideration of the type of failure most likely to be incurred at the "in-use" conditions and design a test circuit effective in the removal of devices which would cause operational failure in the "in-use" circuit.

7.7.2 Effectiveness of Glassing

Glassing appears to have reduced the degree of "n" doped silicon inversion but has not eliminated its occurrence. As pointed out in previous sections, a basic change in inversion voltage requires a redesign of the product. The failure analysis data indicates that the unglassed devices are more susceptable to "n" doped silicon inversion than the glassed devices, but the difference is of degree rather than kind. This is indicated by the fact that 10 unglassed devices and 9 glassed devices suffered from channels in the "n" regions of the device during the life and environmental testing, but 8 of the 9 glassed failures recovered, while only 5 of 10 unglassed devices recovered during room temperature and/or high temperature storage. Of the devices that did not recover, 5 of 10 unlgassed devices were inverted to the point that the leakage characterization of the devices in question appeared resistive on the curve tracer, while only 1 of 9 glassed devices was inverted to this extent.

VIII - TASKS 7 & 8 - SPECIFICATION AND PROCEDURE FOR ENCAPSULATION

8.1 INTRODUCTION

It was the purpose of this task to prepare a complete specification describing the glass encapsulation material found suitable as an encapsulant.

A complete procedure for the encapsulation of semiconductor devices (including monolithic integrated circuits) using the glass material was to be prepared. The procedure is complete and includes details on the application of the material and the processing of the devices.

A number of methods of obtaining films of vitreous SiO_2 have been reported. The method described here is the oxidation of Silane according to the following reaction.

$$SiH_{4(g)} + 2O_{2(g)} \text{--->} SiO_{2(s)} + 2H_2O_{(g)}$$

Silane is a gas that ignites spontaneously in air to form a powdery deposit of colloidal silica. It was found that by diluting the SiH_4 with an inert gas such as N_2 prior to reacting it with O_2, the reaction could be controlled and by proper choice of reaction conditions, transparent, adherent films of SiO_2 can be deposited on semiconductor materials at deposition temperatures ranging from 200°C to 500°C.

8.2 SILANE SYSTEM

Several types of reaction apparatus have been used in the course of this project, but they basically all conform to the same principle of operation. The design and operation of these reaction systems will be discussed here.

The source material is commercially available high purity 3-4% (by volume) silane in Nitrogen, with < 5ppm of water. The oxygen used is dried to < 5ppm. The entire mixture is introduced into the reaction chamber.

The reaction chamber (see sketch) is designed to produce a uniform flow of gases over the deposition area, thus allowing the reaction to take place only where deposition is desired. The reaction by-products are exhausted from an outer chamber around the reaction area. The samples to be coated are placed on an aluminum block under the reaction chamber. The block is heated by a hot plate. As will be shown, deposition rate is temperature sensitive and a temperature controller sensitive to $\pm 1^{o}C$ is used to obtain reproducible results. Figure 28 is a schematic drawing of the reaction apparatus.

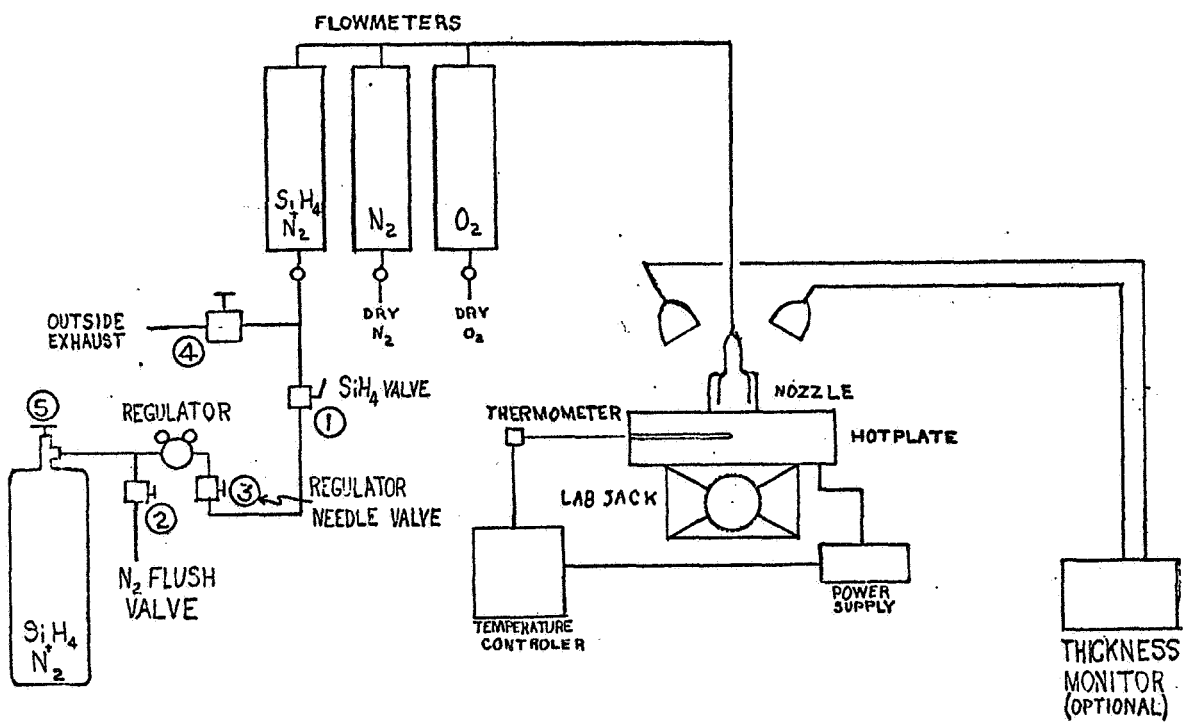


Figure 28. Schematic drawing of SiO_2 vapor plating system.

Gas mixing is done simply by introducing all the metered gases into the reaction chamber from a common manifold (see Figure 28). More complicated systems of mixing, such as water cooled spiraled tubing and quartz chip mixing chambers have been investigated with no improvement in mixing quality.

The design of the reaction chamber is very important in order to effect uniform deposition over a large area while maintaining a high deposition rate, with the prime concerns being total reaction chamber volume, total gas flow and reaction chamber cross-sectional area. Hot plate, or reaction temperature is, of course, important also, and must be controlled to a tight tolerance ($\pm$ 1°C) by a temperature controller. The sample must exhibit a uniform surface temperature; this is accomplished by using a large mass of aluminum as the heat source for the substrate.

8.3 SAFETY PRECAUTIONS

Pure Silane is a toxic, spontaneously combustible gas and should be handled with great caution. Mixtures, by volume, of greater than 5% in an inert gas are flammable, when mixed with oxygen. Precautions should be taken, then, so that the Silane is properly diluted before mixing with oxygen. The entire gas system should be equipped with a nitrogen flushing system to remove all traces of oxygen from the gas lines when changing gas tanks or maintaining the system. The procedure in use is a tee coupling on the SiH_4 tank before the tank regulator. Pure nitrogen can be introduced at this point and the entire reaction apparatus flushed. It is advisable, in order to contain the SiO_2 reaction byproducts, to maintain the entire reaction apparatus inside an exhaust chamber or hood.

8.4 PLATING PARAMETERS

8.4.1 Plating Rate

A discussion of the variables involved in the deposition process can best be approached by first discussing the effects of the gases involved in the reaction and their effect on growth parameters for a particular deposition system.

For the system at hand, the effect of varying SiH_4 and O_2 flows for a fixed N_2 flow is shown in Figure 29 . For a given Silane flow, the deposition rate increases with an increasing flow of oxygen until an O_2:SiH_4 ratio of about 20:1 is reached. At this point, the deposition rate decreases. The explanation for this decrease in rate is that the reaction is now taking place in the gas mixing apparatus at close to room temperature. This fact is evidenced by the formation of SiO_2 in the lines between the gas mixing area and the reaction chamber. The effect of varying the nitrogen flow for a fixed O_2:SiH_4 ratio is shown in Figure 30. Generally, as the flow of nitrogen increases, deposition rate decreases.

8.4.2 Uniformity

The importance of nitrogen flow is better expressed, however, by its effect on the uniformity and quality of the deposit rather than its effect on the uniformity and quality of the deposit rather than its effect on rate of deposition. For very low flows (0-3k cc/min.) a fog of particulate SiO_2 is formed in the reaction chamber. These particles can settle on the substrate causing a high pinhole density in the deposited film. For slightly higher N_2 flows, the deposit

• Silane Flow 2.8 cc/min.
△ Silane Flow 8.4 cc/min.
X Silane Flow 180 cc/min.

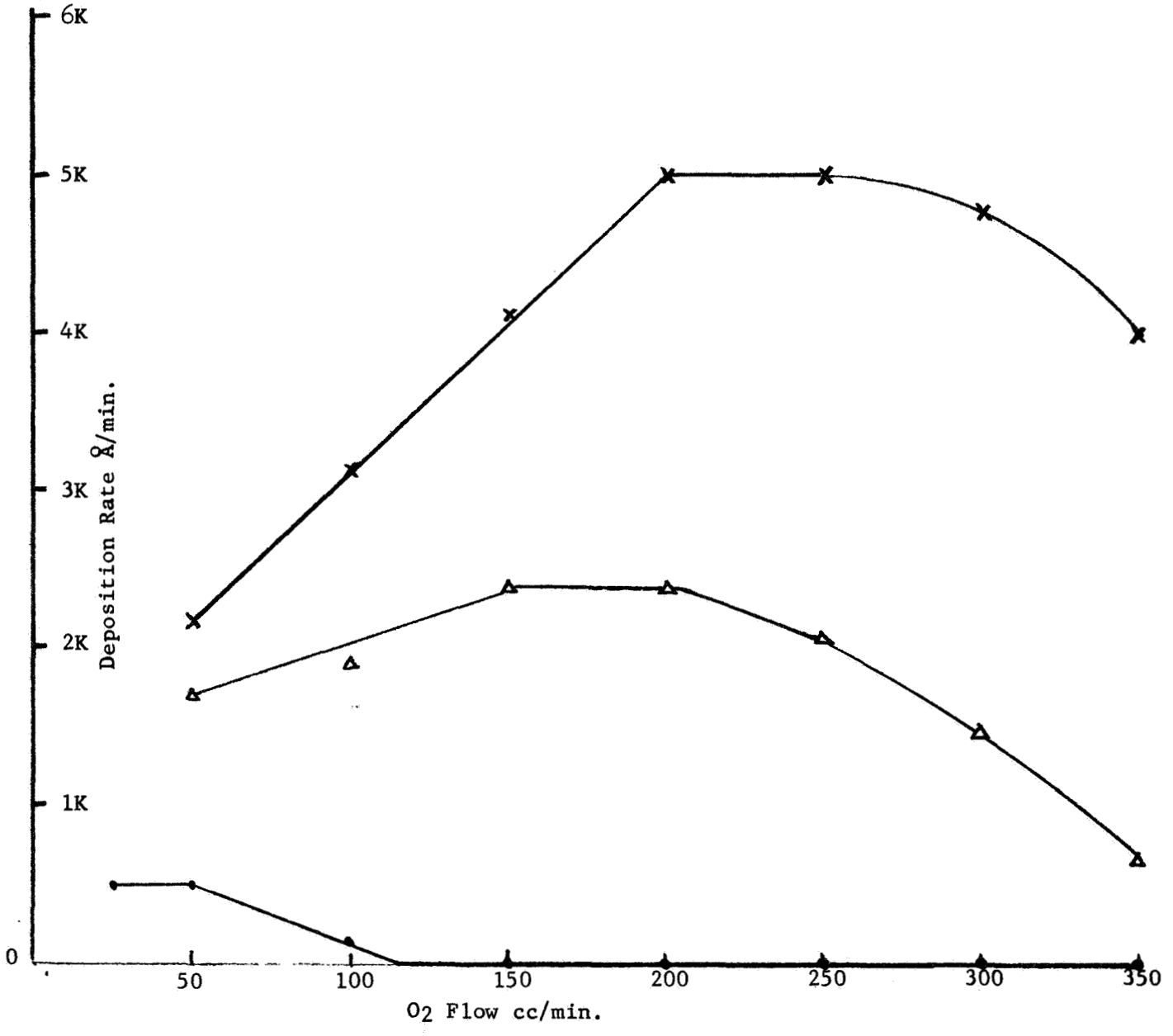
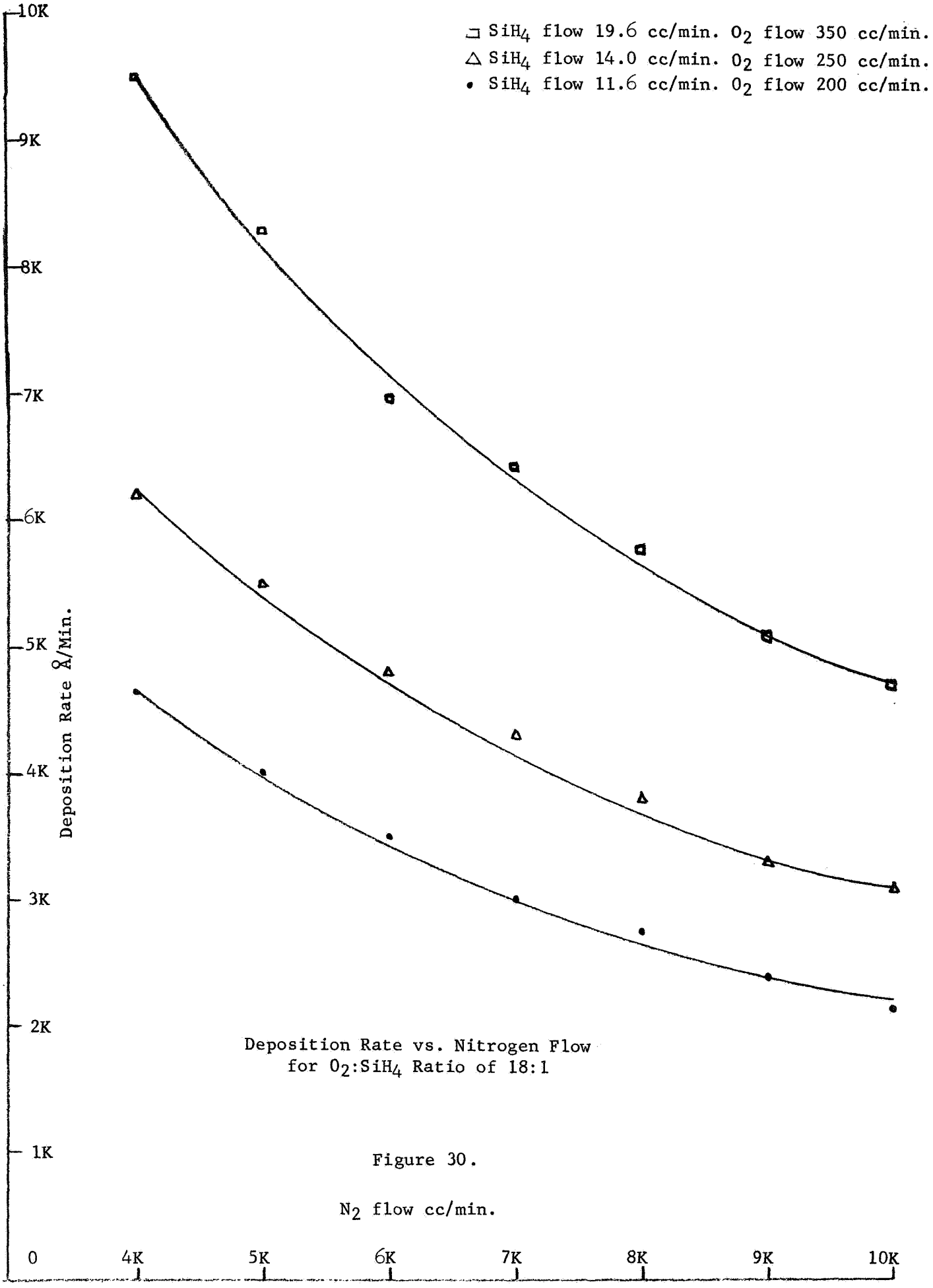


Figure 29.

Effect of Oxygen on Deposition Rate

Nitrogen flow 7000 cc/min.
Hot Plate Temperature 400°C



Deposition Rate vs. Nitrogen Flow
for O_2:SiH_4 Ratio of 18:1

Figure 30.

tends to be thicker in the center of the substrate and for very high flows (> 11k cc/min.) the deposit tends to become thinner in the center of the substrate. A set of flow conditions allowing high deposition rate (5000 Å/min.) and excellent uniformity on 1-1/2" diameter substrates (± 5% in 10 K Å) have been determined and is in use in the production facility.

The effect of deposition temperature on deposition rate is shown in Figure 31.

As temperature increases, for a fixed set of gas flows, the deposition rate increases linearly. Eventually though (depending on gas concentrations) temperature increase no longer has an effect on rate of deposition. This however is usually at a temperature above that at which it is desirable to operate with aluminized substrates, so that only the linear portion of the curve need be of concern. In this region, deposition rate varies approximately 40 - 50 Å/min/^{o}C and displays the necessity for accurately controlling the deposition temperature.

8.4.3 Etching

Since we are depositing SiO_2 on wafers rather than on individual devices, the glass must be delineated and etched so that electrical connections can be made. While the plating parameters have no effect on the etching characteristics of the deposited glass, there is the consideration of etchant temperature. The following is a table of etch rate in BHF composition vs. etchant temperature.

SiH_4 Flow - 19.6 cc/min.
Nitrogen Flow - 6000 cc/min.
Oxygen Flow - 350 cc/min.

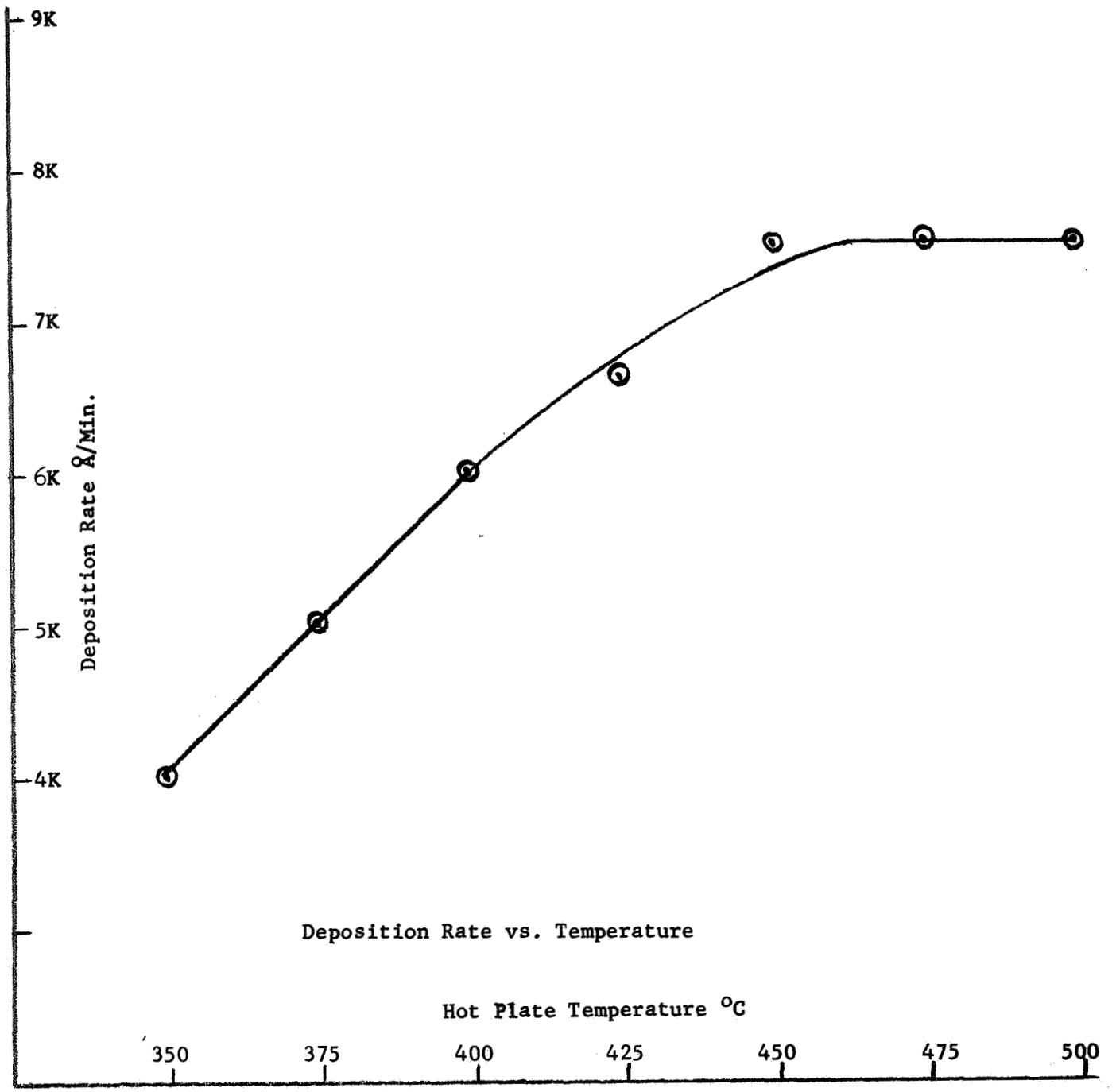


Figure 31.

TABLE XVII

ETCH RATE VS TEMPERATURE

BHF Temp. ^{o}C	Etch Rate Å/sec. ± 10
15	90
22	130
25	160
30	220
40	300

This data indicates that etch rate increases approximately 10 Å/sec. for a $1^{o}C$ increase in temperature. This demonstrates the necessity for controlling the temperature of the etchant in all phases of selective delineation during fabrication of glassed devices.

8.5 CHARACTERISTICS OF THE GLASS

Some of the more important characteristics of SiO_2 deposited by the Silane process are:

1. That is is completely compatible with all the device processing steps that precede it and that the temperature required for deposition be lower than any critical temperature characteristic of semiconductor devices.
2. That it results in a uniform thickness of deposition across the entire substrate.
3. That it has etching characteristics that permit delineation and etching of cuts to contact pad areas of underlying metalization.
4. That it has a very low pinhole density.
5. That it exhibits sufficient rigidity to permit a high level of mechanical protection to the metalized circuit.

Some of the above characteristics have been discussed previously and can be summarized briefly here. Since deposition takes place within a temperature range of 200-500°C (with 400°C being the present operating point) the process is completely compatible with normal semiconductor device fabrication techniques.

With current reaction chamber nozzle designs and proper control of gas flows, uniformity of deposition can be controlled to ±5% for a 10,000Å deposit thickness, across a 1-1/2" diameter substrate. This uniformity could be enhanced by implementation of a system of substrate rotation within the reaction chamber, should greater uniformity be deemed necessary.

Etching characteristics have been proven to be insensitive to deposition parameters. The deposited SiO_2 etches at a constant rate for various combinations of gas flow proportions. This fact is evidenced by the following table.

TABLE XVII

ETCH RATE VERSUS GAS FLOW PROPORTIONS

SiH_4 Flow (cc/min.)	N_2 Flow (cc/min)	O_2 Flow (cc/min)	Etch rate in 23°C BHF (Å/sec. ±10)
14.0	7000	350	150
19.6	4000	175	140
19.6	6000	175	145
28.0	7000	90	140
28.0	4000	175	140

The etch rate has also been found to be insensitive to changes in deposition temperature, as evidenced by the following table.

TABLE XIX

ETCH RATE VS. TEMPERATURE

Deposition Temp. (°C)	Etch rate in 24°C BHF (Å/min. ± 10)
350	160
375	160
400	150
425	160
450	165
475	165
500	165

As shown previously, etch rate is dependent on etchant temperature. With proper control of etch bath temperature, it is possible to make etch cuts of rather small dimensions (1/2 mil square) in deposit thicknesses of up to 15,000 Å.

Pinholes in vapor deposited SiO_2 can be caused by several factors. The formation of particulate SiO_2 in the reaction chamber is a contributor; this can be eliminated by frequent cleaning (every 10 runs) of the reaction chamber and hot plate surface. The factor of prime importance is substrate cleanliness. A thin layer of SiO_2 (approximately 1,000 Å) deposited on a plain silicon wafer is a good visual test for cleanliness. An unclean wafer or an unsatisfactory cleaning process will cause particulate contaminants to be visable as pinholes or areas of non-uniform film thickness. A more sensitive test for pinhole detection is fabrication of capacitors using the deposited layer as a dielectric. A pinhole will act as a shorted capacitor.

By properly cleaning the substrates prior to deposition, pinhole densities of less than one pinhole per 30,000 square mils can be obtained in single layer SiO_2 deposition. This figure is acceptable for any application in which the deposition serves only as a protective layer. For applications where the SiO_2 layer is to be used as a dielectric for capacitor structures or when multilevel metalizations are required, a two-step plating process yields pinhole densities of one pinhole per 150,000 square mils. In this process, the deposition is carried out to one-half the desired thickness, the substrate is then removed, recleaned, and placed back in the reaction chamber for final deposition.

The mechanical protection afforded to circuit metalization has been demonstrated by tests whereby circuits with a without deposited SiO_2 were subjected to conditions that would cause the metalizations to be scratched or abraded. Such a test consists of rubbing two wafers, one glassed and one not, together face-to-face with an abrasive material in between. The following table shows the results of such a test:

TABLE XX

RESULTS OF SCRATCH TESTING

Wafer	Initial Inspection		Final Inspection		% Increase in Scratches
	Unscratched	Scratched	Unscratched	Scratched	
Glassed	265	2	263	3	0.76
Unglassed	258	0	96	162	63.0

It is obvious from this data that a high degree of mechanical protection is afforded by vapor deposited SiO_2. This fact can be further supported by comparison of production yields and visual analysis of lots of circuits fabricated with and without deposited SiO_2. A general decrease of 15 to 20% in visual rejects due to metalization scratching can be expected.

Another consideration for circuit protection is that the deposited SiO_2 layer exhibits a low enough tensile stress to enable it to withstand temperatures in excess of the deposition process that might be encountered in certain packaging operations. The amount of stress inherent in the deposit has been found to be directly proportional to the log of the deposition rate. Glass deposited at 1000 Å/min. has been able to withstand a temperature of 530°C without evidence of cracking. The addition of Phosphine to the reactants in the deposition apparatus greatly lowers the stress, increasing the ability to withstand elevated temperatures.

8.6 SUMMARY

The low temperature oxidation of Silane has been shown to yield controllable, high quality films of SiO_2. This process is compatible with regular device fabrication and yields an oxide that affords enhanced mechanical protection of metalized silicon planar devices.

Another consideration for circuit protection is that the deposited SiO_2 layer exhibits a low enough tensile stress to enable it to withstand temperatures in excess of the deposition process that might be encountered in certain packaging operations. The amount of stress inherent in the deposit has been found to be directly proportional

to the log of the deposition rate. Various controls of the deposition parameters have been effected and a deposition rate has been found which enables the deposited SiO_2 to withstand temperatures in excess of 530°C without evidence of cracking. This deposition rate is 1000 Å/min. and is lower than the standard practiced rate of 5,000 Å/min. but is acceptable in applications where devices are to be packaged in other than metal flat-pack packages. The addition of Phosphine to the reactants in the deposition apparatus greatly lowers the stress, increasing the ability to withstand elevated temperatures.

In summary, the low temperature oxidation of Silane has been shown to yield controllable, high quality films of SiO_2. This process is compatible with regular device fabrication and yields an oxide that affords enhanced mechanical protection of metalized silicon planar devices.

APPENDIX A

METHODS OF DEPOSITION

CONVENTIONAL EVAPORATION

Conventional evaporation, as a technique of film deposition, consists of volatilizing a material located at some position in a vacuum chamber and condensing it on a substrate located at another. The volatilization of the material is usually affected by contact with another more refractory material which is resistively heated.

In general, evaporation is a technique with which the industry has had considerable experience and which possesses the advantages of straight-line transfer of material. Thus it is possible to use masks to accomplish delineation.

The disadvantages of conventional evaporation are : (1) possible contamination of the evaporated glass by material from the refractory heater, and (2) fractionation and distillation of the evaporant when it is a compound.

Hacskaylo[1] has evaporated mixtures of Dy_2O_3, B_2O_3 and SiO_2 (80:40:10 by weight) to form dysprosium borosilicate (rare earth oxide glass) films. The source mixture was evaporated from a tungsten boat; the deposition rate that was obtained was on the order of 200 Å/min; and the films that were deposited ranged from 600Å to 22 μ in thickness. The dielectric constant of the films deposited was about 4.5; the dielectric strength was 4×10^6 V/cm; and the films did not fracture or exhibit mechanical deformation to a temperature of 500°C.

Johansen[2] has evaporated SiO from a tantalum Drumheller source to show that silicon oxide films of reproducible resistivity can be deposited when the evaporation rate, the residual oxygen pressure, the substrate temperature during deposition, and the subsequent heat treatment are controlled. The range of film thickness for the experiment was 0.1 to 1 μ. Depending on the composition of the film, SiO_x, where x varied from below 1 to 2, the resistivity varied from 10^7 to 10^{16} ohm-cm when measured with an applied electric field of 250 V/cm.

Substrates are generally heated to obtain adherent evaporated silicon oxide films. Novice[3] reports that the adherence of oxides evaporated on room temperature substrates can be improved by incorporating a tensile stress in the evaporated layer. This can be achieved by evaporating SiO at oxygen pressures below 10^{-6} torr

so that little oxidation will take place. The resultant film will have the desirable tensile stress in it. When exposed to the atmosphere, a compressive stress, possibly due to the absorption of water molecules, will appear. This will relieve the tensile stress, resulting in a relatively stress-free and stable film.

ELECTRON BEAM EVAPORATION

Electron beam evaporation differs from conventional evaporation only in the means by which energy is supplied to the evaporant. In the electron beam method, a focused beam of electrons produces intense localized heating in the material to be evaporated, thus obviating contact with some other material which must be intensely heated. If the material to be evaporated is an insulator, it is necessary first to raise its temperature until it conducts sufficiently to carry away the charge of the impinging electron beam.

The advantage of electron beam evaporation is its freedom from the contaminations which emanate from the resistively heated coils, boats, and sources used in the conventional technique.

Lewis[4] has evaporated both SiO_2 and Al_2O_3 using the electron beam technique. In the case of the evaporation of SiO_2, he suggests that, because of the dissociation of SiO_2, the glass films that were obtained were either SiO, SiO_2, or an intermediate oxide, depending on the extent of the reoxidation during or after deposition. Although the measured value of refractive index for the films was always 1.5 ± 0.1, the values of dielectric constant varied. Values of 5 were obtained for fast evaporations of about 6000Å/min and values of about 4 for slow evaporations around 300 Å/min. These

were obtained with or without an oxygen leak into the vacuum system. When silica was evaporated onto substrates at 500°C, and then baked in oxygen at 400°C, dielectric constants of 3.6 and 3.9 were obtained. The thickness range for the experiment was 0.8 to 3.4 μ.

In the study of the evaporation of Al_2O_3, rates of 270 Å/min to 2400 Å/min were employed to deposit films ranging from 0.6 to 1.9 μ. The measured values obtained for the dielectric constant and index of refraction were 8.6 ± 0.6 and 1.6 ± 0.05, respectively. Lewis observed that these parameters showed no systematic variations which could be associated with deposition rate, oxygen pressure, or substrate temperature. He concludes that his films are stable in both air and oxygen, and he comments that the low value of dielectric constant compared to the bulk value may possible be due to the porosity of the evaporated oxide.

REACTIVE EVAPORATION

In reactive evaporation, the vacuum chamber in which the operation is performed contains a partial pressure of a gas which is intended to react with the material being evaporated. The reaction may take place at the source at its elevated temperature; it may take place in the vapor phase; it may take place on the substrate; or it may take place in some combination of the preceding ways.

Kaplan[5] has reactively evaporated Al in a partial pressure of 10^{-3} torr of water vapor to obtain aluminum oxide films. Rates as high as 50 Å/sec were attainable for the process. In films which ranged in thickness from 0.1 to 15 μ, dielectric constants

from 2.22 to 4.68 were measured. Kaplan points out that some H_2O must be incorporated in his films; in which case, the dielectric constant would be expected to be higher than the dielectric constant for uncontaminated Al_2O_3. He offers no explanation of why the method results in films with dielectric constants less than bulk.

The reactive evaporation of Al in a partial pressure of O_2 has been performed[6], but the deleterious effects of O_2 at partial pressures above 10^{-3} torr on a hot Al source prevents the use of such high pressures. Below partial pressures of 10^{-3} torr, rates no higher than 5 Å/sec have been obtained.

REACTIVE SPUTTERING

When conventional cathodic sputtering is used as a method of deposition, the material to be deposited is elevated to a high negative potential, usually with respect to a grounded baseplate inside an evacuated bell jar system. An inert gas is bled into the system until a discharge results; and then, as a result of the positive cations bombarding the cathode, material is dislodged and condensed on substrates positioned to receive it. In general, insulators cannot be sputtered because of the build-up of positive charge upon them, and sputtering techniques other than conventional ones must be employed.

In reactive sputtering the electrical discharge takes place in a partial pressure of a reactive rather than a noble gas. The material which condenses on the substrate is the product of the reaction of the gas and the sputtered species. Thus insulators, such as the oxides and the nitrides of certain metals and semiconductors can be formed by a modified sputtering technique.

Janus[7] has reactively sputtered Si in a N_2 atmosphere to obtain adherent silicon nitride films 1.5 μ thick. Rates as high as 100 Å/min were obtained, and the films, as shown by electron diffraction, were amorphous. Transmission electron microscopy showed that the films were free of pinholes greater than 50 Å in diameter. Neither deposition on hot substrates nor post deposition annealing in air altered the structural characteristics. The densities and dielectric constant measured for the films were all lower than bulk values.

Valletta[8] has prepared reactively sputtered silica films by sputtering Si in mixtures of Ar and O_2. The maximum deposition rates obtained were 100 Å/min without an assisting magnetic field, and 2000 Å/min with one. When the sputtering gas contained a high percentage of O_2, infrared spectra revealed that the resulting films were relatively more porous. When the deposition rate was higher than 250 Å/min, the etch rates of the films increased; they became more porous; and they had a higher water content. When the substrate temperature during deposition was between 600°C and 700°C, the silica films were very similar to thermally grown SiO_2. A refractive index of 1.463 ± 0.002 was measured for a film prepared at 100 Å/min in 0.1% O_2 in Ar and a surface temperature of 600°C to 700°C. Etch rates varied from 3 Å/sec for these "best" films to more than 300 Å/sec for films deposited faster than 1000 Å/min.

Frieser[9] has reactively sputtered Al in Ar and O_2 mixtures to form alumina films. He found that the deposition rate tended to decrease as a partial pressure of O_2 in the sputtering gas

mixture increased. He also found that polycrystalline 8-alumina films, which were barely soluble in HF, resulted under conditions of high deposition rates (greater than 10 Å/min) and high substrate temperatures; whereas, at low deposition rates (less than 7 Å/min) and low substrate temperatures, amorphous HF-soluble films were deposited. The density for both types of films was found to be 1.8 $\pm$ 0.2 g/cm^3. The refractive index was measured to be 1.51 $\pm$ 0.03 for the soluble films and 1.62 $\pm$ 0.03 for the barely soluble ones. The dielectric strength of the soluble films was found to be 4×10^5 V/cm, as deposited, and 8×10^5 V/cm after heating at 100°C for three hours. On the basis of the low measured density and the inhomogeneities that were revealed by etching experiments, Frieser concluded that his films were porous.

r-f SPUTTERING

In the r-f sputtering technique, a radio frequency potential is applied to a metal electrode positioned behing the insulating material to be deposited. With this technique, no positive charge build-up will occur on the insulator since both positive ions and electrons will bombard it during opposite phases of the potential cycle. Radio frequencies are required to sputter material from insulators because the phenomenon occurs only after a positive ion sheath is generated about the insulator, and its surface possesses a net negative potential. The effect is due to the difference in mobility of the positive ions and electrons and takes place only when the frequency applied is greater than 10 kHz.

Davidse[10] has obtained the following deposition rates for r-f sputtering at 13.57 MHz: 1200 Å/min for SiO_2, 700 Å/min for GSC-1 glass, 500 Å/min for Pyrex 7740, 400 Å/min for 191CP glass, alumina, and mullite, and 300 Å/min for BN. He has observed that increasing the substrate temperature usually decreases the deposition rate. For example, when the rate for SiO_2 with a substrate temperature of 100°C is 1200 Å/min, it will be 600 Å/min at 500°C, all other conditions being the same. He has also observed that partial pressures of O_2 added to the sputtering gas will decrease the deposition rate; whereas an auxiliary magnetic field of 110 gauss applied normal to the cathode will increase the rate by 30%. The highest deposition rate obtained was 2000 Å/min with SiO_2. He comments that on the basis of acid etch experiments on 2-μ thick films of GSC-1 glass, low pinhole densities can be obtained without extreme precaution.

In addition to the reactively sputtered films of silicon nitride which have been mentioned in the section on reactive sputtering, Janus[7] has also r-f sputtered silicon nitride. All comments made about characteristics noted with the reactively sputtered films also apply to the r-f sputtered ones. The one notable difference is that the etch rate for r-f sputtered silicon nitride has been found to be about an order of magnitude lower than that for reactively sputtered silicon nitride.

VAPOR PLATING

The various vapor plating processes are those methods of depositing films which take place by means of chemical reaction. The material of the substrate is never a principal reactant in

these processes. When energy is required, it is generally supplied in the form of thermal energy. Those systems, in which either radio frequency or microwave energy is used to generate a plasma, are considered separately.

The deposition processes can be classified into two categories: low temperature processes in which the substrate temperature does not exceed, for example, 400°C during deposition or subsequent processing steps, and high temperature processes in which the substrate is heated, either during deposition or during a subsequent sintering step, to 600°C or higher.

On the other hand, the processes can be categorized according to the kind of chemical reaction or phenomenon which causes the deposition to take place. These would be oxidation, disproportionation, pyrolytic decomposition, hydrolysis, and chemical transport.

OXIDATION REACTIONS

Motorola[11] has prepared silica films by means of the oxidation of silane at a temperature of 200°C. With this system deposition rates in the range of 2000 to 5000 Å/min are possible. Dielectric constants of 4.2 have been measured on the films. It has been concluded that the lower deposition rates yield somewhat better dielectric properties. Etch rates of about two orders of magnitude greater than those obtained for thermally grown oxides have been observed.

In addition, Motorola[11] has prepared films of binary and ternary glasses by means of a modification of the oxidation-of-silane method. The glass systems were chosen on the basis of glass

modifiers that would form good dielectrics and help form dense, etch-resistant films.

Borosilicate glass was deposited at 450°C by means of the oxidation of silane with triethylboron alkyl. Uniform films were obtained with thicknesses between 500 and 10,000 Å. Dielectric constants between 4.56 and 6.39 were obtained.

Antimony silicate glass was deposited using silane and tri-n-butyl stibine. Good film uniformity and high deposition temperatures reported was 450°C. Thicknesses were of the order of 2000 Å. Measured dielectric constants were between 2.78 and 5.00. The resistivity ranged from 7.83×10^{13} to 9.5×10^{14} ohm-cm; the dielectric strength, from 3.75×10^{6} to 0.5×10^{6} V/cm.

Boro-aluminosilicate glass films were deposited at temperatures around 400°C using silane, triethylboron, and triethylaluminum. Films between 100 and 2000 Å thick were deposited at rates considered fairly rapid. The ranges of the properties that were measured were: 3.2 to 6.1 for dielectric constant; 4.7×10^{6} to 7.5×10^{6} V/cm for dielectric strength; and 1.2×10^{13} to 4.8×10^{13} ohm-cm for resistivity.

DISPROPORTIONATION REACTIONS

Doo[12] has deposited pyrolytic films of silicon nitride by the disproportionation of silane and ammonia with hydrogen as the carrier gas. Electron microscopy and diffraction indicate that the films are amorphous. Deposition rates of 190, 1800 and 3500 Å/min were obtained for substrate temperatures of 800, 900 and 1000°C, respectively. Cracks were observed in the films that were more

than 1 μ thick. The crack density was found to increase with film thickness and deposition rate. The index of refraction for the films approximately 2. However, when the concentration of NH_3 as a reactant was decreased, the index of refraction rose, indicating an excess of Si. Films deposited at 800°C etched faster than those at 900°C or 1000°C.

Bean[13] also has deposited silicon nitride by the silane-ammonia-hydrogen reaction. His observations are essentially the same as those of Doo. One difference is that in the substrate temperature range of 900°C to 1100°C, Bean observes evidence of crystallinity in his films. Above 1100°C many hexagonal rodlike crystallites grow over the surface which can be identified as Si_3N_4 by x-ray diffraction.

Hu[14] has also deposited silicon nitride films by the same process. He reports an index of refraction of 2.05, a dielectric constant of 6.2, a dielectric strength of the order of 10^7 V/cm, and an electrical resistivity of about 1×10^{15} ohm-cm at 400°C.

Rand[15] has formed silica films by the disproportionation of $SiBr_4$ and CO_2. He obtained rates from 100 to 400 Å/min in the deposition temperature range of 800°C to 950°C. The films contain about 2% residual Br, which apparently is not free to migrate. They are clear, vitreous, adherent, and contain no detectable structure. The index of refraction is 1.48 ± 0.02; the range of the dielectric constant was measured as 3.5 to 4.1; and the dielectric strength is about 2×10^7 V/cm.

Maxwell[16] has deposited silica on platinum and molybdenum substrates at 800°C by means of the disproportionation of $SiCl_4$

and CO_2. He was able to form continuous films at and near a temperature of 800°C provided that the final film thickness was 600 Å or greater. Under the best conditions of deposition, the films had a uniform appearance, had dielectric properties close to those of bulk, and had a high dielectric strength of around 10^7 V/cm. A deposition rate of around 1000 Å/hr was measured at 750°C.

Tung[17] has likewise deposited silica by the disproportionation of $SiCl_4$ and CO_2. He obtained deposition rates on silicon of about 2000 Å/min at temperatures near 1300°C and rates of about 50 Å/min at about 1000°C. The uniformity of his films depended only on the aerodynamics of the gas flow patterns. The films were amorphous as determined by electron diffraction; they had a density of 2.31 $\pm$ 0.02 g/cm^3; the index of refraction was 1.460; the dielectric constant was approximately 4; dielectric strengths of 6×10^6 V/cm were measured; and the resistivity was estimated to be better than 8×10^{14} ohm-cm at room temperature. He also observed that the rate of etching of the silica was higher than the rates obtained for thermally grown layers.

In the same paper Tung[17] reports the deposition of alumina films by means of the pyrolytic disproportionation of $AlCl_3$ and CO_2. The films were transparent and free of pinholes, but polycrystalline as determined by electron diffraction. The index of refractions of the films was 1.76, and the rate of deposition was 820 Å/min at 1200°C. The films exhibited remarkable resistance to hydrofluoric acid etching.

By properly adjusting the flow of hydrogen carrier gas simultaneously over $AlCl_3$ and $SiCl_4$ source materials, Tung [17] was

able to deposit films of the mixed oxides via the same chemical processes. The resultant films had the general appearance of the SiO_2 films and exhibited increased resistance to hydrofluoric acid etching as the alumina content increased.

PYROLYTIC DECOMPOSITION REACTIONS

Klerer[18] has formed silica films by the pyrolytic decomposition of ethyltriethoxysilane. He found that silica films formed on silicon heated to 900°C had an index of refraction of 1.455. At 800°C he was able to form films at the rate of 2000 Å/min, which were clear and continuous up to thicknesses of 200,000 Å. These films withstood temperature cycling from 900°C to liquid nitrogen temperature.

HYDROLYSIS REACTIONS

Barnes[19] has deposited silica films by means of the pyrolytic hydrolysis of $SiBr_4$ at 950°C. He obtained deposition rates of approximately 3000 Å/min, and showed that the films were non-crystalline by x-ray diffraction examination. When N_2 was used as the carrier gas, the resultant films contained $0.3 \pm 0.1\%$ nitrogen. Nevertheless, all films were suitable for use as capacitors up to 600°C.

CHEMICAL TRANSPORT

Chu[20] has deposited silica on silicon substrates at temperatures of 400°C to 600°C using the chemical transport technique with hydrogen fluoride as the transport agent. A closed reaction system was used in which the silicon source material was maintained at 150°C. The equilibrium in this particular reaction is such that the

formation of silica from the gaseous product-reactants is favored at higher temperatures. Deposition rates of about 110 Å/hr near 425°C and about 550 Å/hr near 550°C were obtained. The silica deposited was transparent, amorphous, highly adherent, and free of pinholes. Approximately 1 atomic percent of fluorine was detected in films transported under 10 atmospheres of pressure. The density was measured to be 2.23 ± 0.02 g/cm^3; the refractive index, 1.451 ± 0.003; and the dielectric constant, approximately 3.

In 2M hydrofluoric acid, the dissolution rate of thermally grown SiO_2 was 3 Å/sec. In comparison, silica films transported under 1 to 3 atmospheres of pressure dissolved at 5.3 Å/sec, and those transported under 10 atmospheres pressure, at 6.7 Å/sec.

GLOW DISCHARGE VAPOR DEPOSITION

The difference between glow discharge vapor deposition and ordinary vapor plating is the manner in which energy is supplied to the system so that the chemical reaction can proceed. In the former technique, a radio frequency-or microwave-induced, glow discharge, which is generated at suitably low pressures, rather than heat, is the means of supplying this energy. One proposed mechanism[21] for the reaction is that the ionized gas atoms of the carrier gas collide with the molecules of the reactants, forming free radicals which are absorbed by the surface of the substrate. Further decomposition and reaction can take place at the substrate surface due to the continuous ionic bombardment.

Alt[21] has deposited silica from the decomposition of alkoxysilanes in an argon plasma. Frequencies of 1 to 5 MHz and pressures of 10 to 200 μ were used. Deposition rates of 50 Å/min were

obtained on unheated substrates. The films were amorphous as determined by electron diffraction; uniform in thickness; capable of protecting the silicon substrates in a Cl_2 atmosphere at 900°C to 950°C; and suitable as phosphorus diffusion masks at 1250°C.

Ing[22] has deposited silica films of unknown stoichiometry by decomposing tetraethoxysilane in an oxygen plasma induced by a frequency of 0.5 MHz at a pressure of 90 μ. The deposition rates were varied between 3.5 and 72 Å/min by adjusting the concentrations of tetraethoxysilane. The films had a refractive index of 1.5 ± 0.1; had dielectric constants between 4.5 and 5.5; and were amorphous as determined by electron diffraction.

Secrist[23] has deposited silica films by decomposing tetraethoxysilane in an oxygen plasma. Frequencies of 2.45 KHz/sec were used. The films had refractive indices of 1.458 ± 0.002 and were amorphous as determined by x-ray diffraction. It was determined that the rate of deposition was controlled by physical adsorption. A few heats of absorption were calculated. If bulk density is assumed for the silica, one can calculate the following thickness deposition rates from measured mass deposition rates: for tetraethysilane on a platinum substrate at 306°C, about 19 Å/min; for tetraethoxysilane at the same flow rate on platinum at 306°C, about 31 Å/min.

Sterling[24] has deposited amorphous films of both silica and silicon nitride by glow discharge vapor deposition. Frequencies of 1 MHz and pressures of 100μ were used. Systems with silane and either water vapor, carbon dioxide, or nitrous oxide were capable of yielding silica films. Some water tended to be incorporated in the films, but it was easily eliminated by raising

the substrate temperature to 200°C for deposition. The refractive index was measured to be 1.49.

Amorphous silicon nitride was deposited from systems of silane and ammonia. When the substrates were held at 300°C or higher during deposition, the resultant films were extremely hard and acid resistant. The films had a refractive index of 2.1, a dielectric constant of between 8.0 and 9.0, and a dielectric strength in excess of 5×10^6 V/cm. Both silica and silicon nitride were grown at rates between 550 and 1700 Å/min.

SETTLING

Glass films can be formed by settling colloidal suspensions of glass onto substrates, decanting the suspending fluid, and firing the packed powdered glass at temperatures near its softening point.

Pliskin[25] has formed glass films using suspensions of Corning Pyrex 7740 glass. The glass particles used were generally of the order of 0.1 μ in diameter. Several liquids of different dielectric constants were used as suspending media. The long and short range uniformity of the films was found to depend upon this property of the suspending medium. The suspension was centrifuged at 2000 G for 2 or 3 minutes and fired in a furnace for 10 minutes at 820°C. Uniform, pinhole-free films 4000 Å thick and greater were obtained.

ELECTRON BOMBARDMENT POLYMERIZATION AND OXIDATION

Films of silica can be formed by coating substrates with a thin film of a material, for example triphenylsilanol, by means

of vacuum evaporation, then polymerizing that film by bombarding with an electron beam, and finally oxidizing the resultant polymer to silica.

Woodman[26] has formed films of silica on germanium using this technique. He performed his evaporations of triphenylsilanol from a nickel boat at 1 to 10 μ of pressure. He then bombarded the films with 5 kV electrons at a maximum current of 70 μ to polymerize them. Next, he heated them to 200°C in a vacuum to volatilize any remaining unpolymerized triphenylsilanol. Then, to oxidize the triphenylsilanol films to silica, he heated them in air at 500°C for 90 minutes. Lower temperatures required longer periods of time for complete oxidation. For example, 400°C required 6 hours. The thickness range of the amorphous silica deposited with this technique was from 1000 Å to 5500 Å. As a diffusion mask for germanium, it was effective against antimony but not against indium.

ANALYSIS AND RECOMMENDATIONS

Subsection 2.1 of the report defined the functions of an encapsulant, and, in view of those functions, listed properties that an encapsulant must possess. Next, a group of materials was chosen, each of which has the required properties and has been deposited in film form. An evaluation of those materials in conjunction with the specific methods of depositing them requires (1) considering critically the properties of the materials, (2) considering the limitations and advantages inherent to the methods of deposition and (3) considering the results of the experimenters who have investigated them.

Since the function of glass encapsulation is protection, perhaps the most important property of an encapsulant is freedom from pinholes. Pinholes expose the underlying device to the ambient, creating localized unprotected regions and providing unwanted shorts to metallizations which have been formed on top of the glass layer. The reports cited earlier indicate that SiO_2, Si_3N_4, Al_2O_3, and Corning 7740 glass can be deposited as pinhole-free films. However, other reports indicate that films of SiO_2, and Al_2O_3 which have been deposited are porous. Porosity is a phenomenon which is not defined as well as pinholes are, but if we accept the representation of a porous film as sponge-like on a sub-microscopic level, then it is obvious that porosity in an encapsulant is undesirable. In any event, as film thickness increases, the pinhole density decreases and the poorer protection that a porous film provides is minimized. Hence, if a method of deposition cannot be modified by means of adjusting the deposition parameters or by employment of ultra-clean procedures to yield films with fewer pinholes or less porosity, then thicker films can be used to combat the problem.

A point which is as important as pinholes and porosity is thickness uniformity of the glass layer to prevent thin or weak spots. In addition to planar areas, the surface topography of a microcircuit contains lines and points generated by the intersection of two and three planes, respectively. These are the result of metallizations and contact cuts, and can be represented as inside or outside steps and corners. If deposition occurs via a line-of-sight transfer of material from a small area source,

many problems will be encountered. For the most part, they can be categorized as shadowing occurring at inside steps and corners, resulting in discontinuities in the glass film; and thin or weak spots which occur at outside steps and corners. These difficulties can be minimized by using several distinct sources of material which are strategically positioned, or by using one source displaced from the surface normal to the substrate while simultaneously rotating the substrate about that normal. However, the vapor plating and sputtering techniques by far provide the most uniform film layers which are completely lacking in the irregularities just described.

If no pinhole or porosity problems exist, but the film has a dielectric constant higher than desirable, then at a given thickness, parasitic capacitances may be excessive. As before, increasing the film thickness will tend to eliminate the problem. In genreal, the considerations of pinholes, excessive porosity, and parasitic capacitance due to high dielectric constant will establish the lower limit of film thickness.

In devices, contact cuts must be made through the encapsulating glass layer to underlying strata. The resolution of the delineation of these cuts will depend upon the thickness of the glass layer and impose an upper limit on it. The practical lower limit required for protection depends on whether it is less that the upper limit; that is, whether it is thin enough to be delineated.

Given a material with a suitable dielectric constant and lacking pinholes and porosity at a reasonable thickness, the next consideration would be a practical one. The deposition rate for

the material must be high enough that the desired thickness can be obtained in a reasonable time. If we arbitrarily choose one micron of material in two hours to be a minimum acceptable deposition rate, then, according to the references cited earlier, the following systems would fail to meet the minimum rate requirement: SiO_2 deposited by glow discharge vapor deposition, SiO_2 deposited by chemical transport, Si_3N_4 deposited by conventional reactive sputtering, and Al_2O_3 deposited by conventional reactive sputtering. However, there is a possibility that if the reactive sputtering of Al_2O_3 and Si_3N_4 were performed in a magnetic field, the rates would be somewhat increased. On the other hand, the fastest rates of film formation that were reported were 6000 Å/min for SiO_2 deposited by electron beam evaporation, 5000 Å/min for SiO_2 deposited by the oxidation of silane, 3500 Å/min for Si_3N_4 deposited by the reaction of silane and ammonia, and 3000 Å/min for Al_2O_3 deposited by reactive evaporation.

The preceding considerations of deposition rates do not apply to the formation of glass films by settling, since that method does not involve a cumulative type of film formation.

A very important consideration in the deposition of a glass layer on a microcircuit is the temperature required for the deposition. Since the majority of microcircuits utilize aluminum metallization for contact to the silicon, a maximum allowable temperature is determined by the aluminum-silicon eutectic, 577°C. If this temperature is chosen as the maximum temperature range permissible during the deposition of a glass layer, all but two of the vapor plating techniques are eliminated as possible

methods for depositing glass encapsulants. Silica has been deposited by the oxidation of silane at 200°C, and binary and ternary glasses have been deposited by modifications of the method at temperatures no higher than 450°C. The deposition of SiO_2 by chemical transport has been conducted at temperatures of only 400°C to 600°C.

A consideration related to the temperature required for deposition of the glass encapsulant is the necessity for matching thermal coefficients of expansion of the glass layer and the silicon wafer. For the most part, the values of the thermal coefficient of expansion of the glassing materials match the value for silicon reasonably well. This indicates that there will be a minimum of film cracking and poor adhesion resulting from thermal coefficient of expansion mismatch. The greatest mismatch is found for SiO_2. The thermal coefficient of expansion of SiO_2 is about $5.4 \times 10^{-7}/°C$, while the value for silicon is $42 \times 10^{-7}/°C$. However, even in this case, Philco's experience with SiO_2 vapor plated by oxidation of silane indicates no problems for encapsulating layers less than 20,000 Å thick.

Because contact cuts must be etched through the glass encapsulating layer, another property required for the glass layer is etchability. All the glasses considered as encapsulants possess a reasonable degree of etchability except Si_3N_4, which is very resistant to acid etching. However, this material need not be eliminated as a possible encapsulant because, under certain deposition conditions, very porous films of Si_3N_4 have been obtained which etch at reasonable rates. Therefore, there is the possibility

that Si_3N_4 can be deposited in such a form, delineated, etched, and finally densified by a bake at some elevated temperature.

Two further criteria in the choice of the glass materials as possible protective films are stability and inertness. Comments have already been made on the increased solubility of glass films due to excessive porosity. Another phenomenon which affects stability and inertness is the inclusion of unwanted impurities. Certain films of reactively sputtered SiO_2 were reported to contain high percentages of oxygen: when nitrogen was used as the carrier gas in the pyrolytic hydrolysis of $SiBr_4$, the resultant SiO_2 films contained measurable amounts of nitrogen; when films of SiO_2 were formed by the disproportionation of $SiBr_4$ and CO_2, they contained as much as 2% residual bromine; and water was found to be incorporated in the films of SiO_2 that were formed by glow discharge vapor deposition using silane. Control of the composition of the deposited glass material might be expected to be simplified in the case of single component glasses, i.e., SiO_2.

The deposition methods of settling and electron bombardment polymerization plus oxidation must be considered separately. Settling is unsatisfactory for depositing a glass encapsulant because the radii of the colloidal glass particles which are used are very much greater than the radii of the inside steps and corners present in microcircuits. As a result, a uniformly intimate contact cannot be achieved with this method. In addition, the film tends to include impurities mainly due to the suspending medium. Electron bombardment polymerization plus oxidation can

be eliminated for several reasons. The resultant films are porous, as indicated be their poor masking properties. It is doubtful whether complete oxidation of the polymer takes place at temperatures below 500°C within reasonable times. The method involves vacuum evaporation of an initial film and the electron bombardment of it, both of which are line-of-sight processes resulting in nonuniformities as discussed above.

One last but very important factor in the consideration and selection of the glassing material and deposition process is the possible inclusion of mobile alkali ions, hydrogen ions, or mobile charge in general. At the time glassing techniques were originally developed, the importance of ion contamination phenomena was not realized. Accordingly, when glassing materials were selected, adequate consideration was not given to the importance of controlling ion concentrations and/or electrical fields to insure reliable devices.

It has been shown that planar diodes and transistors have a number of reliability problems due to surface phenomena. Degradations occurring during operating life have often been found to be reversible. This type of instability was attributed by a number of investigators[27-29] to the motion of ions on the surface, with the resultant formation of a channel. The lateral ion migration hypothesis was widely accepted until the advent of studies directed toward understanding the phenomena of threshold voltage of MOS transistors.

The significance of charge motion in the oxide of planar devices was first realized in studies of instability of insulated-

gate field effect (MOST) devices. As a result of intensive investigations in a number of laboratories, it became evident that motion of alkali (especially sodium) ions and of protons in thermally grown oxides is a major factor in the stability of MOS devices. Thus, one of the properties desired in a glassing material is complete absence of mobile alkali ions.

After it was demonstrated that transverse migration of cations, particulatly sodium ions in the oxide, was the cause of instability in MOS transistors, many workers concluded that transverse ion migration was the cause of all surface related instability in all planar devices. While transverse ion migration, including sodium and hydrogen ions, is the principal cause of instability in MOS devices, particularly those having a gate electrode which overlaps the source and drain regions, such as p-channel enchancement mode MOS devices, lateral ion migration is also a factor in planar oxide stability.

A further complication makes it difficult to predict the magnitude of electrical fields along the surface of the dielectric at various places on the surface of a transistor. This arises from the fact that in many cases, the surface conductivity of the electric is high relative to its bulk conductivity. Moreover, the surface conductivity varies with the degree of surface contamination by ions, with the degree of absorption of water or other polar molecules, and with ambient temperature. For example, the surface conductivity of an electrical grade borosilicate is increased by approximately five orders of magnitude by increasing relative humidity from 10% to 90%.

Two types of techniques have been developed for producing MOS devices and arrays which have reasonably low threshold voltage and are relatively stable. In one approach, the wafers are oxidized, processed, and metallized under conditions which minimize the sodium and hydrogen ion contamination which would lead to device instability. The other approach, which is more important to selecting a glassing process, avoids gross sodium contamination and a phosphorus diffusion is applied to produce a thin phosphosilicate layer on the surface of the thermally grown oxide. The phosphosilicate layer effectively getters any mobile sodium or hydrogen ions present in the thermally grown oxide, or subsequently introduced during aluminum metallization. Since the phosphosilicate layer can result in small polarization effects, a relatively thin (less than 0.1 μ) $P_2O_5 \cdot SiO_2$ layer has been considered more desirable than a thick (0.3 μ) layer.

This, then, is one of the considerations which must be taken into account when choosing a material to be used in glassing of silicon wafers. It has been shown, for example, that B_2O_3 can render a $P_2O_5 \cdot SiO_2$ layer incapable of gettering sodium. Also, it would be expected that the P_2O_5-containing layer would be incapable of gettering and immobilizing more than one cation of any type per phosphorus atom. Accordingly, a thin phosphosilicate layer covered by a borosilicate glass, such as Corning No. 7740 or a lead borosilicate glass, would not be capable of immobilizing mobile cations.

Furthermore, commercially available glasses generally have an appreciable alkali ion content which would exceed the available

phosphorus, and thus cause device reliability problems. Even "alkali-free" glass (Corning No. 7059) has been found to contain several hundred ppm sodium.

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APPENDIX B

STATISTICAL DATA FOR REVERSE BIAS TESTING

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UGO	R-518	D287	L4054	025 C	ENV	FE	17

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
1	0	0	0	3	13	0	0	0	0	IRG09	AMP	0.4800-007 / 0.2000-007	0.4406-007 / 0.6290-008
5.9	0.	0.	0.	17.6	76.5	0.	0.	0.	0.			
0	0	0	8	0	5	0	3	1	0	IGR04	AMP	0.5100-007 / 0.4700-007	0.4788-007 / 0.1111-008
0.	0.	0.	47.1	0.	29.4	0.	17.6	5.9	0.			
0	0	2	0	11	0	2	0	2	0	IBR04	AMP	0.5100-007 / 0.4800-007	0.4924-007 / 0.8314-009
0.	0.	11.8	0.	64.7	0.	11.8	0.	11.8	0.			
1	0	0	0	7	5	3	1	0	0	IRB02	AMP	0.4900-007 / 0.4000-007	0.4559-007 / 0.1805-008
5.9	0.	0.	0.	41.2	29.4	17.6	5.9	0.	0.			
0	0	5	0	4	0	7	1	0	0	IGB02	AMP	0.5000-007 / 0.4700-007	0.4824-007 / 0.9781-009
0.	0.	29.4	0.	23.5	0.	41.2	5.9	0.	0.			
0	0	2	2	0	9	2	2	0	0	IBG09	AMP	0.4900-007 / 0.4500-007	0.4700-007 / 0.1118-008
0.	0.	11.8	11.8	0.	52.9	11.8	11.8	0.	0.			
0	0	3	0	2	9	1	1	1	0	IRC01	AMP	0.5000-007 / 0.4500-007	0.4655-007 / 0.1317-008
0.	0.	17.6	0.	11.8	52.9	5.9	5.9	5.9	0.			
0	2	0	0	0	12	0	2	1	0	IGB01	AMP	0.4900-007 / 0.4500-007	0.4700-007 / 0.9384-009
0.	11.8	0.	0.	0.	70.6	0.	11.8	5.9	0.			
0	0	2	3	0	8	0	3	1	0	IGG01	AMP	0.4900-007 / 0.4500-007	0.4658-007 / 0.1054-008
0.	0.	11.8	17.6	0.	47.1	0.	17.6	5.9	0.			
0	0	0	1	15	0	0	0	0	1	IGE01	AMP	0.2150-008 / 0.2700-007	0.5555-007 / 0.4142-007
0.	0.	0.	5.9	88.2	0.	0.	0.	0.	5.9			

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UGD	R518N	1318	L4054	025 C	340	XH	16

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0 / 0.	1 / 6.2	2 / 12.5	0 / 0.	7 / 43.7	2 / 12.5	0 / 0.	4 / 25.0	0 / 0.	0 / 0.	IRG09	AMP	0.4600-007 / 0.3900-007	0.4306-007 / 0.1806-008
0 / 0.	1 / 6.2	1 / 6.2	2 / 12.5	1 / 6.2	9 / 56.2	0 / 0.	2 / 12.5	0 / 0.	0 / 0.	IBR04	AMP	0.4800-007 / 0.4000-007	0.4469-007 / 0.8089-008
0 / 0.	1 / 6.2	1 / 6.2	0 / 0.	5 / 31.2	7 / 43.7	1 / 6.2	1 / 6.2	0 / 0.	0 / 0.	IBR04	AMP	0.5000-007 / 0.4100-007	0.4706-007 / 0.8048-008
0 / 0.	1 / 6.2	1 / 6.2	0 / 0.	4 / 25.0	7 / 43.7	0 / 0.	3 / 18.7	0 / 0.	0 / 0.	IRB02	AMP	0.4800-007 / 0.3900-007	0.4538-007 / 0.8419-008
0 / 0.	1 / 6.2	0 / 0.	3 / 18.7	3 / 18.7	2 / 12.5	6 / 37.5	1 / 6.2	0 / 0.	0 / 0.	IBB02	AMP	0.4900-007 / 0.4100-007	0.4656-007 / 0.1965-008
0 / 0.	0 / 0.	2 / 12.5	2 / 12.5	5 / 31.2	2 / 12.5	2 / 12.5	3 / 18.7	0 / 0.	0 / 0.	IBG09	AMP	0.4800-007 / 0.4100-007	0.4519-007 / 0.8257-008
0 / 0.	1 / 6.2	3 / 18.7	0 / 0.	2 / 12.5	5 / 31.2	5 / 31.2	0 / 0.	0 / 0.	0 / 0.	IRC01	AMP	0.4600-007 / 0.4100-007	0.4456-007 / 0.1489-008
0 / 0.	1 / 6.2	1 / 6.2	1 / 6.2	8 / 50.0	2 / 12.5	0 / 0.	3 / 18.7	0 / 0.	0 / 0.	IDB01	AMP	0.4800-007 / 0.4300-007	0.4613-007 / 0.1360-008
0 / 0.	1 / 6.2	2 / 12.5	2 / 12.5	0 / 0.	10 / 62.5	0 / 0.	1 / 6.2	0 / 0.	0 / 0.	IDG01	AMP	0.4700-007 / 0.4000-007	0.4456-007 / 0.8220-008
0 / 0.	0 / 0.	0 / 0.	1 / 6.2	14 / 87.5	0 / 0.	0 / 0.	0 / 0.	0 / 0.	1 / 6.2	IDE01	AMP	0.2150-006 / 0.2300-007	0.9275-007 / 0.4363-007

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UGD	R518N	2208	L4054	025 C	694	XH	14

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	0	0	13	0	0	0	1	IRG09	AMP	0.1360-006	0.6064-007
0.	0.	0.	0.	92.9	0.	0.	0.	7.1			0.5100-007	0.2183-007
0	0	0	2	8	3	0	0	1	IGR04	AMP	0.6700-007	0.5850-007
0.	0.	0.	14.3	57.1	21.4	0.	0.	7.1			0.5400-007	0.3180-008
0	1	1	0	1	8	3	0	0	IBR04	AMP	0.5800-007	0.5671-007
0.	7.1	7.1	0.	7.1	57.1	21.4	0.	0.			0.5300-007	0.1326-008
1	0	0	0	3	8	1	1	0	IRB02	AMP	0.5900-007	0.5443-007
7.1	0.	0.	0.	21.4	57.1	7.1	7.1	0.			0.4300-007	0.3631-008
0	0	1	4	4	0	3	2	0	IGB02	AMP	0.5900-007	0.5907-007
0.	0.	7.1	28.6	28.6	0.	21.4	14.3	0.			0.5500-007	0.1207-008
0	1	0	0	7	2	0	4	0	IBG09	AMP	0.5800-007	0.5564-007
0.	7.1	0.	0.	50.0	14.3	0.	28.6	0.			0.5300-007	0.1277-008
0	0	1	3	5	1	0	4	0	IRC01	AMP	0.5700-007	0.5629-007
0.	0.	7.1	21.4	35.7	7.1	0.	28.6	0.			0.5300-007	0.1326-008
0	0	4	0	3	5	0	2	0	IGB01	AMP	0.5800-007	0.5556-007
0.	0.	28.6	0.	21.4	35.7	0.	14.3	0.			0.5300-007	0.1336-008
0	0	5	0	2	4	0	3	0	IDG01	AMP	0.5700-007	0.5443-007
0.	0.	35.7	0.	14.3	28.6	0.	21.4	0.			0.5300-007	0.1342-008
0	0	0	0	13	0	0	0	1	IDE01	AMP	0.2120-006	0.6493-007
0.	0.	0.	0.	92.9	0.	0.	0.	7.1			0.5200-007	0.4235-007

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UGO	R518N	3068	L4054	025 C	10C	XH	14

	*3STD	*2STD	*1STD	*.67STD	MEAN	*.67STD	*1STD	*2STD	*3STD	NAMA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	0	0	1	8	3	1	0	0	1	IRG09	AMP	0.5500-007 / 0.4600-007	0.4821-007 / 0.8289-008
	0.	0.	0.	7.1	57.1	21.4	7.1	0.	0.	7.1			
	1	0	0	2	1	9	1	0	0	0	IGR04	AMP	0.4800-007 / 0.4100-007	0.4629-007 / 0.1729-008
	7.1	0.	0.	14.3	7.1	64.3	7.1	0.	0.	0.			
	0	0	3	0	6	0	4	0	1	0	IBR04	AMP	0.5000-007 / 0.4700-007	0.4821-007 / 0.8926-009
	0.	0.	21.4	0.	42.9	0.	28.6	0.	7.1	0.			
	0	0	1	0	8	2	0	3	0	0	IRB02	AMP	0.4900-007 / 0.4600-007	0.4750-007 / 0.9405-009
	0.	0.	7.1	0.	57.1	14.3	0.	21.4	0.	0.			
	0	0	4	0	2	7	0	1	0	0	IGB02	AMP	0.5000-007 / 0.4700-007	0.4836-007 / 0.1008-008
	0.	0.	28.6	0.	14.3	50.0	0.	7.1	0.	0.			
	0	1	3	0	1	8	0	1	0	0	IBG09	AMP	0.5200-007 / 0.4800-007	0.5036-007 / 0.1151-008
	0.	7.1	21.4	0.	7.1	57.1	0.	7.1	0.	0.			
	0	0	6	0	0	3	0	5	0	0	IRC01	AMP	0.5100-007 / 0.4900-007	0.4993-007 / 0.9169-009
	0.	0.	42.9	0.	0.	21.4	0.	35.7	0.	0.			
	0	0	5	0	1	7	0	1	0	0	ICB01	AMP	0.5200-007 / 0.4900-007	0.5029-007 / 0.1069-008
	0.	0.	35.7	0.	7.1	50.0	0.	7.1	0.	0.			
	0	1	0	0	9	1	0	3	0	0	ICG01	AMP	0.5100-007 / 0.4700-007	0.4936-007 / 0.1082-008
	0.	7.1	0.	0.	64.3	7.1	0.	21.4	0.	0.			
	0	0	0	0	13	0	0	0	0	1	ICE01	AMP	0.2310-006 / 0.4500-007	0.5136-007 / 0.4884-007
	0.	0.	0.	0.	92.9	0.	0.	0.	0.	7.1			

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4054	R5180	7098	UGO	025 G	40G	XH	14

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	4	1	1	3	2	3	0	0	IRG09	AMP	0.5100-007 / 0.4693-007
0.	0.	28.6	7.1	7.1	21.4	14.3	21.4	0.	0.			0.4100-007 / 0.3689-008
0	0	3	3	0	3	1	4	0	0	IGR04	AMP	0.5300-007 / 0.4879-007
0.	0.	21.4	21.4	0.	21.4	7.1	28.6	0.	0.			0.4300-007 / 0.3945-008
0	0	2	4	0	1	6	1	0	0	IBR04	AMP	0.5600-007 / 0.5000-007
0.	0.	14.3	28.6	0.	7.1	42.9	7.1	0.	0.			0.4300-007 / 0.4350-008
0	0	2	4	0	1	6	1	0	0	IRB02	AMP	0.5600-007 / 0.5071-007
0.	0.	14.3	28.6	0.	7.1	42.9	7.1	0.	0.			0.4300-007 / 0.4250-008
0	0	5	0	1	5	2	1	0	0	IGB02	AMP	0.6000-007 / 0.5207-007
0.	0.	35.7	0.	7.1	35.7	14.3	7.1	0.	0.			0.4600-007 / 0.4565-008
0	0	3	2	1	1	6	1	0	0	IBG09	AMP	0.5300-007 / 0.4871-007
0.	0.	21.4	14.3	7.1	7.1	42.9	7.1	0.	0.			0.4300-007 / 0.4027-008
0	0	4	1	1	2	6	0	0	0	IRG01	AMP	0.5600-007 / 0.5200-007
0.	0.	28.6	7.1	7.1	14.3	42.9	0.	0.	0.			0.4600-007 / 0.4224-008
0	0	4	2	0	1	6	1	0	0	IGB01	AMP	0.6000-007 / 0.5243-007
0.	0.	28.6	14.3	0.	7.1	42.9	7.1	0.	0.			0.4600-007 / 0.4941-008
0	0	5	0	1	1	7	0	0	0	IGG01	AMP	0.5600-007 / 0.5150-007
0.	0.	35.7	0.	7.1	7.1	50.0	0.	0.	0.			0.4300-007 / 0.5215-008
0	0	0	0	13	0	0	0	0	1	IGE01	AMP	0.2500-006 / 0.6543-007
0.	0.	0.	0.	92.9	0.	0.	0.	0.	7.1			0.4200-007 / 0.5480-007

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UGD	R-518	D287	L4054	025 C	ENV	FE	17

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	1	0	5	0	6	0	5	0	0	IECOT	AMP	0.3300-007 / 0.3000-007	0.3188-007 / 0.8295-009
	0.	5.9	0.	29.4	0.	35.3	0.	29.4	0.	0.				
	0	0	0	0	13	2	1	0	0	1	IEBOT	AMP	0.2570-006 / 0.4900-007	0.7912-007 / 0.4490-007
	0.	0.	0.	0.	76.5	11.8	5.9	0.	0.	5.9				
	0	0	0	1	13	0	1	1	0	1	BTATL	AMP	0.1961-003 / 0.1137-004	0.4541-004 / 0.4792-004
	0.	0.	0.	5.9	76.5	0.	5.9	5.9	0.	5.9				
	0	0	0	2	12	0	0	2	1	0	BTATM	AMP	0.3812-002 / 0.6797-003	0.1432-002 / 0.9122-003
	0.	0.	0.	11.8	70.6	0.	0.	11.8	5.9	0.				
	1	0	0	0	5	8	2	1	0	0	IDBOC	AMP	0.5400-007 / 0.3900-007	0.4841-007 / 0.8043-008
	5.9	0.	0.	0.	29.4	47.1	11.8	5.9	0.	0.				
	1	0	0	0	6	9	0	1	0	0	IDEOC	AMP	0.5200-007 / 0.3100-007	0.4724-007 / 0.4395-008
	5.9	0.	0.	0.	35.3	52.9	0.	5.9	0.	0.				
	0	0	0	8	0	6	2	0	0	1	IECOB	AMP	0.3800-007 / 0.3300-007	0.3588-007 / 0.1269-008
	0.	0.	0.	47.1	0.	35.3	11.8	0.	0.	5.9				
	0	0	4	0	5	4	1	3	0	0	IEBOB	AMP	0.1290-006 / 0.4900-007	0.5400-007 / 0.8406-007
	0.	0.	23.5	0.	29.4	23.5	5.9	17.6	0.	0.				
	0	0	0	0	14	0	1	1	0	1	BTAUL	AMP	0.2203-003 / 0.1183-004	0.4542-004 / 0.5069-004
	0.	0.	0.	0.	82.4	0.	5.9	5.9	0.	5.9				
	0	0	0	1	13	0	0	2	1	0	BTAUM	AMP	0.3748-002 / 0.7016-003	0.1402-002 / 0.8656-003
	0.	0.	0.	5.9	76.5	0.	0.	11.8	5.9	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UQO	R518N	1318	L405*	029 C	340	XH	16

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	MEAN VALUE / LOW VALUE	MEAN / STD
0	1	1	2	5	4	0	3	0	0	IECOT	AMP	0.3300-007 / 0.2700-007	0.3113-007 / 0.1986-008
0.	6.2	6.2	12.5	31.2	25.0	0.	18.7	0.	0.				
0	0	0	1	11	2	1	0	0	1	IEBOT	AMP	0.2290-006 / 0.4800-007	0.7813-007 / 0.4443-007
0.	0.	0.	6.2	68.7	12.5	6.2	0.	0.	6.2				
0	0	0	1	12	0	1	1	0	1	BTATL	AMP	0.2164-003 / 0.1304-004	0.7241-004 / 0.5553-004
0.	0.	0.	6.2	75.0	0.	6.2	6.2	0.	6.2				
0	0	0	2	11	0	0	2	1	0	BTATW	AMP	0.3725-002 / 0.6818-003	0.1446-002 / 0.9043-003
0.	0.	0.	12.5	68.7	0.	0.	12.5	6.2	0.				
0	2	0	0	3	9	1	1	0	0	IDBOC	AMP	0.5100-007 / 0.3900-007	0.4644-007 / 0.8245-008
0.	12.5	0.	0.	18.7	56.2	6.2	6.2	0.	0.				
0	1	1	0	5	6	1	2	0	0	IDECO	AMP	0.5000-007 / 0.3000-007	0.4550-007 / 0.4789-008
0.	6.2	6.2	0.	31.2	37.5	6.2	12.5	0.	0.				
0	0	5	0	3	3	3	2	0	0	IECOB	AMP	0.3600-007 / 0.2800-007	0.3169-007 / 0.8469-008
0.	0.	31.2	0.	18.7	18.7	18.7	12.5	0.	0.				
0	0	4	0	5	3	1	3	0	0	IEBOB	AMP	0.1270-006 / 0.4700-007	0.5119-007 / 0.8459-007
0.	0.	25.0	0.	31.2	18.7	6.2	18.7	0.	0.				
0	0	0	2	11	1	0	1	0	1	BTACL	AMP	0.2165-003 / 0.1592-004	0.7011-004 / 0.5068-004
0.	0.	0.	12.5	68.7	6.2	0.	6.2	0.	6.2				
0	0	0	2	11	0	0	2	1	0	BTACW	AMP	0.3603-002 / 0.4850-003	0.1400-002 / 0.8240-003
0.	0.	0.	12.5	68.7	0.	0.	12.5	6.2	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UGO	R518N	2208	L4054	025 C	694	XH	14

*3STD	*2STD	*1STD	*.67STD	MEAN	*.67STD	*1STD	*2STD	*3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	0	0	13	0	0	0	0	1	IECOT	AMP	0.7900-007	0.4350-007
0.	0.	0.	0.	92.9	0.	0.	0.	0.	7.1			0.3900-007	0.1026-007
0	0	0	3	8	0	0	2	1	0	IEBOT	AMP	0.1260-006	0.7664-007
0.	0.	0.	21.4	57.1	0.	0.	14.3	7.1	0.			0.5700-007	0.2086-007
0	0	0	0	12	0	0	1	1	0	BTATL	AMP	0.1887-003	0.4544-004
0.	0.	0.	0.	85.7	0.	0.	7.1	7.1	0.			0.1440-004	0.4792-004
0	0	0	1	11	0	0	1	1	0	BTATH	AMP	0.3700-002	0.1384-002
0.	0.	0.	7.1	78.6	0.	0.	7.1	7.1	0.			0.6827-003	0.8447-003
0	0	1	3	0	8	0	2	0	0	IDBOC	AMP	0.5900-007	0.5693-007
0.	0.	7.1	21.4	0.	57.1	0.	14.3	0.	0.			0.5500-007	0.1072-008
1	0	0	0	1	12	0	0	0	0	IDEOC	AMP	0.5800-007	0.5393-007
7.1	0.	0.	0.	7.1	85.7	0.	0.	0.	0.			0.2600-007	0.8138-008
0	0	0	7	0	4	2	0	1	0	IECOB	AMP	0.4500-007	0.4186-007
0.	0.	0.	50.0	0.	28.6	14.3	0.	7.1	0.			0.4100-007	0.1167-008
0	0	3	1	5	1	1	3	0	0	IEBOB	AMP	0.1370-006	0.8936-007
0.	0.	21.4	7.1	35.7	7.1	7.1	21.4	0.	0.			0.5600-007	0.2613-007
0	0	0	0	12	1	0	0	0	1	BTACL	AMP	0.1964-003	0.4237-004
0.	0.	0.	0.	85.7	7.1	0.	0.	0.	7.1			0.1201-004	0.4653-004
0	0	0	1	11	0	0	1	1	0	BTACH	AMP	0.3595-002	0.1332-002
0.	0.	0.	7.1	78.6	0.	0.	7.1	7.1	0.			0.6751-003	0.7916-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UQD	R518N	3068	L4054	025 C	10C	XH	14

	*3STD	*2STD	*1STD	*.67STD	MEAN	*.67STD	*1STD	*2STD	*3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	1	2	0	4	6	0	1	0	0	IECOT	AMP	0.4100-007 / 0.3700-007	0.3929-007 / 0.1069-008
	0.	7.1	14.3	0.	28.6	42.9	0.	7.1	0.	0.				
	0	0	0	3	8	0	0	2	1	0	IEBOT	AMP	0.1240-006 / 0.5600-007	0.7500-007 / 0.8086-007
	0.	0.	0.	21.4	57.1	0.	0.	14.3	7.1	0.				
	0	0	0	0	12	0	0	1	0	1	BTATL	AMP	0.3014-003 / 0.2197-004	0.6893-004 / 0.7570-004
	0.	0.	0.	0.	85.7	0.	0.	7.1	0.	7.1				
	0	0	0	1	11	0	0	1	1	0	BTATH	AMP	0.3754-002 / 0.6915-003	0.1400-002 / 0.8596-003
	0.	0.	0.	7.1	78.6	0.	0.	7.1	7.1	0.				
	0	0	1	0	7	2	2	1	1	0	ICBOG	AMP	0.5300-007 / 0.4700-007	0.4979-007 / 0.1528-008
	0.	0.	7.1	0.	50.0	14.3	14.3	7.1	7.1	0.				
	1	0	0	0	0	13	0	0	0	0	ICEOG	AMP	0.4900-007 / 0.1000-008	0.4521-007 / 0.1274-007
	7.1	0.	0.	0.	0.	92.9	0.	0.	0.	0.				
	0	0	1	0	11	1	0	0	0	1	IECOB	AMP	0.4600-007 / 0.3800-007	0.4021-007 / 0.1805-008
	0.	0.	7.1	0.	78.6	7.1	0.	0.	0.	7.1				
	0	0	3	1	5	1	1	3	0	0	IEBOB	AMP	0.1370-006 / 0.5600-007	0.8779-007 / 0.8566-007
	0.	0.	21.4	7.1	35.7	7.1	7.1	21.4	0.	0.				
	0	0	0	0	12	1	0	0	0	1	BTACL	AMP	0.3687-003 / 0.1912-004	0.6906-004 / 0.8895-004
	0.	0.	0.	0.	85.7	7.1	0.	0.	0.	7.1				
	0	0	0	1	11	0	0	1	1	0	BTACH	AMP	0.3655-002 / 0.6840 003	0.1347-002 / 0.8090 003
	0.	0.	0.	7.1	78.6	0.	0.	7.1	7.1	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4054	R5180	7898	UGG	025 G	400	XH	14

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	3	3	0	4	0	4	0	0	IECOT	AMP	0.3900-007 / 0.3300-007	0.3664-007 / 0.2205-008
0.	0.	21.4	21.4	0.	28.6	0.	28.6	0.	0.				
0	0	0	4	7	0	1	1	1	0	IEBOT	AMP	0.1330-006 / 0.5700-007	0.7607-007 / 0.2205-007
0.	0.	0.	28.6	50.0	0.	7.1	7.1	7.1	0.				
0	0	0	1	11	0	0	1	1	0	BTATL	AMP	0.1892-003 / 0.1600-004	0.4914-004 / 0.4746-004
0.	0.	0.	7.1	78.6	0.	0.	7.1	7.1	0.				
0	0	0	1	11	0	0	1	1	0	BTATH	AMP	0.3556-002 / 0.6740-003	0.1371-002 / 0.8014-003
0.	0.	0.	7.1	78.6	0.	0.	7.1	7.1	0.				
0	0	3	2	1	1	6	1	0	0	ICBOG	AMP	0.5800-007 / 0.4400-007	0.5259-007 / 0.4784-008
0.	0.	21.4	14.3	7.1	7.1	42.9	7.1	0.	0.				
1	0	0	0	5	8	0	0	0	0	ICEOG	AMP	0.5600-007 / 0.1000-007	0.4886-007 / 0.1192-007
7.1	0.	0.	0.	35.7	57.1	0.	0.	0.	0.				
0	0	2	3	0	6	1	2	0	0	IEOOB	AMP	0.4300-007 / 0.3700-007	0.3953-007 / 0.1785-008
0.	0.	14.3	21.4	0.	42.9	7.1	14.3	0.	0.				
0	0	3	1	5	1	1	3	0	0	IEBOB	AMP	0.1300-006 / 0.5400-007	0.9107-007 / 0.2811-007
0.	0.	21.4	7.1	35.7	7.1	7.1	21.4	0.	0.				
0	0	0	0	12	1	0	0	0	1	BTAGL	AMP	0.2092-003 / 0.1360-004	0.4595-004 / 0.4817-004
0.	0.	0.	0.	85.7	7.1	0.	0.	0.	7.1				
0	0	0	1	11	0	0	1	1	0	BTAGH	AMP	0.3490-002 / 0.6430-003	0.1303-002 / 0.7553-003
0.	0.	0.	7.1	78.6	0.	0.	7.1	7.1	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UQQ	R-518	D287	L4054	025 C	ENV	FE	17

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	2	0	11	1	1	1	1	0	ID1C2	AMP	0.5300-007 / 0.4500-007	0.4735-007 / 0.2029-008
0.	0.	11.8	0.	64.7	5.9	5.9	5.9	5.9	0.				
0	0	2	0	6	6	0	2	1	0	ID2C1	AMP	0.4900-007 / 0.4500-007	0.4665-007 / 0.1057-008
0.	0.	11.8	0.	35.3	35.3	0.	11.8	5.9	0.				
0	0	0	0	16	0	0	0	0	1	ID600	AMP	0.1430-004 / 0.1080-006	0.9546-005 / 0.3439-005
0.	0.	0.	0.	94.1	0.	0.	0.	0.	5.9				
0	0	0	5	8	1	0	2	1	0	STACK	AMP	0.6243-004 / 0.7633-005	0.2182-004 / 0.1559-004
0.	0.	0.	29.4	47.1	5.9	0.	11.8	5.9	0.				
0	0	2	3	5	4	0	2	1	0	STATI	AMP	0.7026-004 / 0.8257-005	0.2852-004 / 0.1652-004
0.	0.	11.8	17.6	29.4	23.5	0.	11.8	5.9	0.				
0	0	0	0	14	0	0	1	2	0	IDSLI	AMP	0.7899-004 / 0.4100-006	0.1551-004 / 0.2700-004
0.	0.	0.	0.	82.4	0.	0.	5.9	11.8	0.				
0	0	0	3	10	1	0	2	1	0	IDSH	AMP	0.1040-003 / 0.1459-004	0.3821-004 / 0.2833-004
0.	0.	0.	17.6	58.8	5.9	0.	11.8	5.9	0.				
0	1	0	3	10	0	1	0	2	0	ILP	AMP	0.1200-006 / 0.1140-006	0.1171-006 / 0.1391-008
0.	5.9	0.	17.6	58.8	0.	5.9	0.	11.8	0.				
0	0	0	8	2	3	1	2	1	0	IL-12	AMP	0.1080-006 / 0.1030-006	0.1044-006 / 0.1698-008
0.	0.	0.	47.1	11.8	17.6	5.9	11.8	5.9	0.				
0	0	3	0	9	3	0	1	1	0	IL-11	AMP	0.1260-006 / 0.1180-006	0.1211-006 / 0.1784-008
0.	0.	17.6	0.	52.9	17.6	0.	5.9	5.9	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UGC	R518N	1318	L4054	025 C	340	XH	16

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	2	1	5	5	0	3	0	0	IC1CG	AMP	0.4900-007 / 0.3900-007	0.4313-007 / 0.8181-008
0.	0.	12.5	6.2	31.2	31.2	0.	18.7	0.	0.				
0	0	3	0	5	2	2	4	0	0	IC2CL	AMP	0.4600-007 / 0.3900-007	0.4281-007 / 0.8713-008
0.	0.	18.7	0.	31.2	12.5	12.5	25.0	0.	0.				
0	0	0	0	15	0	0	0	0	1	IC6GG	AMP	0.1428-004 / 0.1050-006	0.100 -005 / 0.8541-005
0.	0.	0.	0.	93.7	0.	0.	0.	0.	6.2				
0	0	0	5	7	1	0	2	1	0	BTACI	AMP	0.6200-004 / 0.7698-005	0.2860-004 / 0.1570-004
0.	0.	0.	31.2	43.7	6.2	0.	12.5	6.2	0.				
0	0	1	3	6	3	1	1	1	0	BTATI	AMP	0.7057-004 / 0.8337-005	0.2978-004 / 0.1652-004
0.	0.	6.2	18.7	37.5	18.7	6.2	6.2	6.2	0.				
0	0	0	0	13	0	0	1	2	0	IDSLI	AMP	0.759 -004 / 0.5500-006	0.1546-004 / 0.8663-004
0.	0.	0.	0.	81.2	0.	0.	6.2	12.5	0.				
0	0	0	4	8	1	0	2	1	0	IDSW	AMP	0.9811-004 / 0.1366-004	0.3644-004 / 0.8768-004
0.	0.	0.	25.0	50.0	6.2	0.	12.5	6.2	0.				
0	0	0	7	4	1	0	4	0	0	ILB	AMP	0.1220-006 / 0.1110-006	0.1142-006 / 0.8936-008
0.	0.	0.	43.7	25.0	6.2	0.	25.0	0.	0.				
0	1	1	1	8	0	2	3	0	0	IL-12	AMP	0.1110-006 / 0.9800-007	0.1046-006 / 0.8504-008
0.	6.2	6.2	6.2	50.0	0.	12.5	18.7	0.	0.				
0	1	1	0	7	2	1	4	0	0	IL-11	AMP	0.1250-006 / 0.1090-006	0.1196-006 / 0.4289-008
0.	6.2	6.2	0.	43.7	12.5	6.2	25.0	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
U90	RS18N	2208	L4054	025 C	694	XH	14

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	4	0	4	3	1	2	0	0	IC1CE	AMP	0.5900-007 / 0.5300-007	0.5521-007 / 0.1929-008
0.	0.	28.6	0.	28.6	21.4	7.1	14.3	0.	0.				
0	0	2	3	0	6	0	3	0	0	IC2CL	AMP	0.5700-007 / 0.5300-007	0.5479-007 / 0.1122-008
0.	0.	14.3	21.4	0.	42.9	0.	21.4	0.	0.				
0	0	0	0	13	0	0	0	0	1	IC6GO	AMP	0.1422-004 / 0.1270-004	0.1144-005 / 0.8764-005
0.	0.	0.	0.	92.9	0.	0.	0.	0.	7.1				
0	0	0	4	7	1	0	1	1	0	BTACK	AMP	0.6186-004 / 0.7663-005	0.2135-004 / 0.1439-004
0.	0.	0.	28.6	50.0	7.1	0.	7.1	7.1	0.				
0	0	1	2	5	4	0	1	1	0	BTATI	AMP	0.7045-004 / 0.8300-005	0.2845-004 / 0.1511-004
0.	0.	7.1	14.3	35.7	28.6	0.	7.1	7.1	0.				
0	0	0	0	12	0	0	0	2	0	IDBL	AMP	0.7621-004 / 0.5700-006	0.1303-004 / 0.8568-004
0.	0.	0.	0.	85.7	0.	0.	0.	14.3	0.				
0	0	0	2	9	0	1	1	1	0	IDSH	AMP	0.9830-004 / 0.1413-004	0.3868-004 / 0.8695-004
0.	0.	0.	14.3	64.3	0.	7.1	7.1	7.1	0.				
0	0	0	6	0	6	0	2	0	0	IL5	AMP	0.1370-006 / 0.1350-006	0.1357-006 / 0.9263-009
0.	0.	0.	42.9	0.	42.9	0.	14.3	0.	0.				
0	0	1	5	0	4	2	2	0	0	IL-12	AMP	0.1240-006 / 0.1200-006	0.1219-006 / 0.1207-008
0.	0.	7.1	35.7	0.	28.6	14.3	14.3	0.	0.				
0	0	0	8	0	4	0	1	1	0	IL-11	AMP	0.1430-006 / 0.1400-006	0.1406-006 / 0.9288-009
0.	0.	0.	57.1	0.	28.6	0.	7.1	7.1	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
U90	RS16N	3068	L405M	025 C	10C	XM	14

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	MEAN VALUE / LOW VALUE	MEAN / SPD
	0	0	1	0	6	5	0	1	1	0			
	0.	0.	7.1	0.	42.9	35.7	0.	7.1	7.1	0.			
	0	0	1	0	6	5	0	1	1	0	IC1CR	AMP	0.5400-007 / 0.4700-007	0.5000-007 / 0.1797-008
	0.	0.	7.1	0.	42.9	35.7	0.	7.1	7.1	0.	IC2CL	AMP	0.5000-007 / 0.4600-007	0.4764-007 / 0.1008-008
	0	0	0	0	13	0	0	0	0	1	IC6GQ	AMP	0.1423-004 / 0.1120-004	0.1152-005 / 0.3770-005
	0.	0.	0.	0.	92.9	0.	0.	0.	0.	7.1				
	0	0	0	4	7	1	0	1	1	0	BTADI	AMP	0.6844-004 / 0.7706-005	0.2147-004 / 0.1496-004
	0.	0.	0.	28.6	50.0	7.1	0.	7.1	7.1	0.				
	0	0	1	2	5	4	0	1	1	0	BTATI	AMP	0.7066-004 / 0.8350-005	0.2853-004 / 0.1914-004
	0.	0.	7.1	14.3	35.7	28.6	0.	7.1	7.1	0.				
	0	0	0	0	12	0	0	0	2	0	IDSL	AMP	0.7655-004 / 0.7700-004	0.1322-004 / 0.2571-004
	0.	0.	0.	0.	85.7	0.	0.	0.	14.3	0.				
	0	0	0	2	9	0	1	1	1	0	IDSH	AMP	0.9853-004 / 0.1402-004	0.3446-004 / 0.2675-004
	0.	0.	0.	14.3	64.3	0.	7.1	7.1	7.1	0.				
	0	0	0	0	8	5	0	0	1	0	ILB	AMP	0.1230-006 / 0.1200-006	0.1206-006 / 0.8516-009
	0.	0.	0.	0.	57.1	35.7	0.	0.	7.1	0.				
	0	0	2	0	8	0	0	4	0	0	IL-LR	AMP	0.1060-006 / 0.1010-006	0.1034-006 / 0.1585-008
	0.	0.	14.3	0.	57.1	0.	0.	28.6	0.	0.				
	0	0	4	0	3	4	0	3	0	0	IL-LI	AMP	0.1280-006 / 0.1250-006	0.1244-006 / 0.1588-008
	0.	0.	28.6	0.	21.4	28.6	0.	21.4	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4054	R5180	7098	UGO	025 C	406	XH	14

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	1	3	0	0	7	1	2	0	0	IC162	AMP	0.5600-007 / 0.4100-007	0.5109-007 / 0.4915-008
0.	7.1	21.4	0.	0.	50.0	7.1	14.3	0.	0.				
0	1	0	1	4	2	6	0	0	0	IC2C1	AMP	0.5400-007 / 0.3000-007	0.4836-007 / 0.6640-008
0.	7.1	0.	7.1	28.6	14.3	42.9	0.	0.	0.				
0	0	0	0	13	0	0	0	0	1	IC6G0	AMP	0.1438-004 / 0.6700-007	0.1119-005 / 0.3818-005
0.	0.	0.	0.	92.9	0.	0.	0.	0.	7.1				
0	0	1	3	5	3	0	1	1	0	BTAGI	AMP	0.5812-004 / 0.7208-005	0.2065-004 / 0.1340-004
0.	0.	7.1	21.4	35.7	21.4	0.	7.1	7.1	0.				
0	0	2	1	4	5	0	1	1	0	BTATI	AMP	0.4047-004 / 0.7819-005	0.2759-004 / 0.1419-004
0.	0.	14.3	7.1	28.6	35.7	0.	7.1	7.1	0.				
0	0	0	0	12	0	0	0	2	0	IDSL	AMP	0.7647-004 / 0.4100-006	0.1329-004 / 0.2561-004
0.	0.	0.	0.	85.7	0.	0.	0.	14.3	0.				
0	0	0	1	10	0	1	1	1	0	IDSH	AMP	0.9903-004 / 0.1402-004	0.3409-004 / 0.2716-004
0.	0.	0.	7.1	71.4	0.	7.1	7.1	7.1	0.				
0	0	2	4	0	1	6	1	0	0	IL5	AMP	0.1000-006 / 0.8500-007	0.9759-007 / 0.7654-008
0.	0.	14.3	28.6	0.	7.1	42.9	7.1	0.	0.				
0	0	4	2	0	1	7	0	0	0	IL-12	AMP	0.9400-007 / 0.7400-007	0.8629-007 / 0.7770-008
0.	0.	28.6	14.3	0.	7.1	50.0	0.	0.	0.				
0	0	5	1	0	1	7	0	0	0	IL-11	AMP	0.1110-006 / 0.9200-007	0.1031-006 / 0.8142-008
0.	0.	35.7	7.1	0.	7.1	50.0	0.	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GD	R-518	D287	L4054	025 C	ENV	FE	40

-3STD	-2STD	-1STD	-.675STD	MEAN	+.675STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	0	0	37	2	0	0	0	1	IRQ09	AMP	0.5100-006 / 0.2900-007	0.5938-007 / 0.9567-007
0.	0.	0.	0.	92.5	5.0	0.	0.	0.	2.5				
1	1	1	0	3	32	2	0	0	0	IGR04	AMP	0.5100-007 / 0.2300-007	0.4665-007 / 0.4555-008
2.5	2.5	2.5	0.	7.5	80.0	5.0	0.	0.	0.				
1	0	1	3	7	22	4	2	0	0	IBR04	AMP	0.5300-007 / 0.3900-007	0.4900-007 / 0.8148-008
2.5	0.	2.5	7.5	17.5	55.0	10.0	5.0	0.	0.				
0	0	0	0	37	2	0	0	0	1	IRB02	AMP	0.1110-006 / 0.4300-007	0.4770-007 / 0.1033-007
0.	0.	0.	0.	92.5	5.0	0.	0.	0.	2.5				
1	0	2	0	19	6	8	3	1	0	IBB02	AMP	0.5100-007 / 0.4200-007	0.4768-007 / 0.1542-008
2.5	0.	5.0	0.	47.5	15.0	20.0	7.5	2.5	0.				
2	1	1	0	7	28	1	0	0	0	IBG09	AMP	0.4900-007 / 0.3100-007	0.4835-007 / 0.4112-008
5.0	2.5	2.5	0.	17.5	70.0	2.5	0.	0.	0.				
0	1	0	0	34	4	0	0	0	1	IRC01	AMP	0.1050-006 / 0.2100-007	0.4705-007 / 0.1063-007
0.	2.5	0.	0.	85.0	10.0	0.	0.	0.	2.5				
1	0	4	0	19	11	0	2	3	0	ICB01	AMP	0.5000-007 / 0.4300-007	0.4935-007 / 0.1275-008
2.5	0.	10.0	0.	47.5	27.5	0.	5.0	7.5	0.				
1	0	1	6	7	19	4	1	0	1	ICG01	AMP	0.5300-007 / 0.3700-007	0.4640-007 / 0.8148-008
2.5	0.	2.5	15.0	17.5	47.5	10.0	2.5	0.	2.5				
0	0	0	1	37	1	0	0	0	1	ICE01	AMP	0.3900-006 / 0.1200-007	0.5375-007 / 0.8667-007
0.	0.	0.	2.5	92.5	2.5	0.	0.	0.	2.5				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GU	R518N	1318	L4054	025 C	340	XH	34

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	0	1	2	18	12	0	0	0	1			
	0.	0.	2.9	5.9	52.9	35.3	0.	0.	0.	2.9		0.1060-006 / 0.3100-007	0.4547-007 / 0.1169-007
	0	1	5	0	8	6	11	3	0	0			
	0.	2.9	14.7	0.	23.5	17.6	32.4	8.8	0.	0.		0.4800-007 / 0.3800-007	0.4438-007 / 0.6349-008
	1	0	1	0	10	16	0	6	0	0			
	2.9	0.	2.9	0.	29.4	47.1	0.	17.6	0.	0.		0.4900-007 / 0.4100-007	0.4600-007 / 0.5518-008
	0	0	0	1	27	5	0	0	0	1			
	0.	0.	0.	2.9	79.4	14.7	0.	0.	0.	2.9		0.1040-006 / 0.3900-007	0.4659-007 / 0.1038-007
	0	2	3	2	8	11	5	3	0	0			
	0.	5.9	8.8	5.9	23.5	32.4	14.7	8.8	0.	0.		0.5100-007 / 0.3900-007	0.4559-007 / 0.8904-008
	0	4	0	1	5	17	6	1	0	0			
	0.	11.8	0.	2.9	14.7	50.0	17.6	2.9	0.	0.		0.5100-007 / 0.2900-007	0.4568-007 / 0.8629-008
	0	0	0	0	27	6	0	0	0	1			
	0.	0.	0.	0.	79.4	17.6	0.	0.	0.	2.9		0.1020-006 / 0.4100-007	0.4671-007 / 0.1003-007
	0	2	0	6	10	11	0	5	0	0			
	0.	5.9	0.	17.6	29.4	32.4	0.	14.7	0.	0.		0.4900-007 / 0.3900-007	0.4503-007 / 0.2209-008
	1	0	1	10	4	10	6	2	0	0			
	2.9	0.	2.9	29.4	11.8	29.4	17.6	5.9	0.	0.		0.4700-007 / 0.3100-007	0.4315-007 / 0.8164-008
	0	0	0	0	33	0	0	0	0	1			
	0.	0.	0.	0.	97.1	0.	0.	0.	0.	2.9		0.4310-006 / 0.1400-007	0.5212-007 / 0.4723-007

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
00	R518N	2208	L4054	025 C	694	XH	32

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
1 / 3.1	2 / 6.2	0 / 0.	0 / 0.	4 / 12.5	21 / 65.6	4 / 12.5	0 / 0.	0 / 0.	0 / 0.	IRQ09	AMP	0.5700-007 / 0.4100-007	0.5569-007 / 0.8930-008
1 / 3.1	0 / 0.	0 / 0.	0 / 0.	13 / 40.6	18 / 56.2	0 / 0.	0 / 0.	0 / 0.	0 / 0.	IGR04	AMP	0.5800-007 / 0.2900-007	0.5503-007 / 0.4856-008
1 / 3.1	0 / 0.	3 / 9.4	0 / 0.	15 / 46.9	0 / 0.	11 / 34.4	2 / 6.2	0 / 0.	0 / 0.	IBR04	AMP	0.5900-007 / 0.5300-007	0.5719-007 / 0.1176-008
0 / 0.	0 / 0.	8 / 25.0	0 / 0.	9 / 28.1	10 / 31.2	0 / 0.	5 / 15.6	0 / 0.	0 / 0.	IRB02	AMP	0.5700-007 / 0.5300-007	0.5525-007 / 0.1244-008
1 / 3.1	0 / 0.	3 / 9.4	0 / 0.	4 / 12.5	19 / 59.4	3 / 9.4	1 / 3.1	1 / 3.1	0 / 0.	IGB02	AMP	0.6000-007 / 0.5200-007	0.5678-007 / 0.1358-008
2 / 6.2	1 / 3.1	0 / 0.	0 / 0.	6 / 18.7	23 / 71.9	0 / 0.	0 / 0.	0 / 0.	0 / 0.	IBQ09	AMP	0.5800-007 / 0.4100-007	0.5503-007 / 0.4526-008
0 / 0.	3 / 9.4	2 / 6.2	0 / 0.	1 / 46.9	0 / 0.	9 / 28.1	3 / 9.4	0 / 0.	0 / 0.	IRC01	AMP	0. 700-007 / 0.5300-007	0. 22-007 / 0.1059-008
0 / 0.	1 / 3.1	3 / 9.4	0 / 0.	12 / 37.5	8 / 25.0	0 / 0.	8 / 25.0	0 / 0.	0 / 0.	ICB01	AMP	0.5700-007 / 0.5300-007	0.5559-007 / 0.1073-008
1 / 3.1	0 / 0.	0 / 0.	0 / 0.	12 / 37.5	16 / 50.0	3 / 9.4	0 / 0.	0 / 0.	0 / 0.	ICQ01	AMP	0.5600-007 / 0.4200-007	0.5416-007 / 0.8384-008
0 / 0.	0 / 0.	0 / 0.	1 / 3.1	30 / 93.7	0 / 0.	0 / 0.	0 / 0.	0 / 0.	1 / 3.1	ICE01	AMP	0.4220-006 / 0.4000-008	0.6275-007 / 0.6616-007

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GU	R518N	3068	L4054	025 C	10C	XH	32

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
1 / 3.1	1 / 3.1	1 / 3.1	0 / 0.	9 / 28.1	18 / 56.2	0 / 0.	1 / 3.1	1 / 3.1	0 / 0.	IRQ09	AMPI	0.3700-007 / 0.3300-007	0.4819-007 / 0.4358-008
0 / 0.	0 / 0.	3 / 9.4	0 / 0.	22 / 68.7	0 / 0.	0 / 0.	6 / 18.7	0 / 0.	1 / 3.1	IBR04	AMPI	0.5000-007 / 0.4600-007	0.4719-007 / 0.9578-009
0 / 0.	0 / 0.	5 / 15.6	6 / 18.7	0 / 0.	17 / 53.1	0 / 0.	3 / 9.4	1 / 3.1	0 / 0.	IBR04	AMPI	0.5100-007 / 0.4700-007	0.4866-007 / 0.9708-009
0 / .	0 / .	1 / 3.1	0 / .	21 / 65.6	5 / 15.6	0 / .	4 / 12.5	1 / 3.1	0 / .	IRB02	AMPI	0.5000-007 / .46 - 7	0.4747-007 / .8793- 9
0 / 0.	0 / 0.	6 / 18.7	3 / 9.4	0 / 0.	14 / 43.7	5 / 15.6	4 / 12.5	0 / 0.	0 / 0.	IQB02	AMPI	0.5100-007 / 0.4700-007	0.4894-007 / 0.1243-008
2 / 6.2	1 / 3.1	0 / 0.	0 / 0.	7 / 21.9	21 / 65.6	1 / 3.1	0 / 0.	0 / 0.	0 / 0.	IBQ09	AMPI	0.5300-007 / 0.3500-007	0.4909-007 / 0.4503-008
0 / 0.	1 / 3.1	6 / 18.7	0 / 0.	5 / 15.6	15 / 46.9	0 / 0.	5 / 15.6	0 / 0.	0 / 0.	IRC01	AMPI	0.5200-007 / 0.4600-007	0.5055-007 / 0.1077-008
1 / 3.1	0 / 0.	0 / 0.	4 / 12.5	9 / 28.1	14 / 43.7	3 / 9.4	1 / 3.1	0 / 0.	0 / 0.	IDB01	AMPI	0.5300-007 / 0.4100-007	0.5051-007 / 0.1042-008
1 / 3.1	0 / 0.	0 / 0.	3 / 9.4	16 / 50.0	5 / 15.6	7 / 21.9	0 / 0.	0 / 0.	0 / 0.	IDQ01	AMPI	0.5100-007 / 0.3900-007	0.4909-007 / 0.8161-008
0 / 0.	0 / 0.	0 / 0.	1 / 3.1	30 / 93.7	0 / 0.	0 / 0.	0 / 0.	0 / 0.	1 / 3.1	IDE01	AMPI	0.4270-006 / 0.9000-008	0.5869-007 / 0.6759-007

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4654	R518N	7098	00	025 0	400	XH	28

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
1	0	1	5	4	9	2	6	0	0	IRG09	AMP	0.5100-007 / 0.2000-007	0.4250-007 / 0.6899-008
3.6	0.	3.6	17.9	14.3	32.1	7.1	21.4	0.	0.				
0	1	5	1	5	6	3	7	0	0	IGR04	AMP	0.5300-007 / 0.2800-007	0.4446-007 / 0.7016-008
0.	3.6	17.9	3.6	17.9	21.4	10.7	25.0	0.	0.				
0	0	6	3	3	6	1	9	0	0	IBR04	AMP	0.5500-007 / 0.3600-007	0.4654-007 / 0.6155-008
0.	0.	21.4	10.7	10.7	21.4	3.6	32.1	0.	0.				
0	0	6	2	6	4	3	7	0	0	IRB02	AMP	0.5600-007 / 0.3600-007	0.4707-007 / 0.6353-008
0.	0.	21.4	7.1	21.4	14.3	10.7	25.0	0.	0.				
0	0	6	2	4	6	5	5	0	0	IGB02	AMP	0.5700-007 / 0.3700-007	0.4821-007 / 0.6425-008
0.	0.	21.4	7.1	14.3	21.4	17.9	17.9	0.	0.				
0	1	1	5	8	4	2	7	0	0	IBG09	AMP	0.5400-007 / 0.2300-007	0.4414-007 / 0.7184-008
0.	3.6	3.6	17.9	28.6	14.3	7.1	25.0	0.	0.				
0	0	7	2	5	4	2	8	0	0	IRC01	AMP	0.5600-007 / 0.3600-007	0.4771-007 / 0.6841-008
0.	0.	25.0	7.1	17.9	14.3	7.1	28.6	0.	0.				
0	0	6	3	5	4	2	8	0	0	ICB01	AMP	0.5800-007 / 0.3700-007	0.4819-007 / 0.6821-008
0.	0.	21.4	10.7	17.9	14.3	7.1	28.6	0.	0.				
0	0	7	2	6	3	6	4	0	0	IGG01	AMP	0.5700-007 / 0.3700-007	0.4714-007 / 0.6878-008
0.	0.	25.0	7.1	21.4	10.7	21.4	14.3	0.	0.				
1	0	0	6	9	2	3	7	0	0	IGE01	AMP	0.5600-007 / 0.1700-007	0.4464-007 / 0.6731-008
3.6	0.	0.	21.4	32.1	7.1	10.7	25.0	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
60	R-518	D287	L4054	025 C	ENV	FI	40

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	13	0	0	16	0	11	0	0	IECOT	AMP	0.3300-007 / 0.3100-007	0.3195-007 / 0.9828-009
0.	0.	32.5	0.	0.	40.0	0.	27.5	0.	0.				
0	0	0	12	15	2	3	5	3	0	IEBOT	AMP	0.2100-006 / 0.4300-007	0.9583-007 / 0.8569-007
0.	0.	0.	30.0	37.5	5.0	7.5	12.5	7.5	0.				
0	0	4	7	14	6	2	6	0	1	BTATL	AMP	0.1151-003 / 0.9490-005	0.3695-004 / 0.2216-004
0.	0.	10.0	17.5	35.0	15.0	5.0	15.0	0.	2.5				
0	0	8	3	16	0	0	13	0	0	BTATW	AMP	0.2779-002 / 0.4775-003	0.1430-002 / 0.7497-003
0.	0.	20.0	7.5	40.0	0.	0.	32.5	0.	0.				
0	0	6	2	16	5	0	11	0	0	IDBOC	AMP	0.5200-007 / 0.4700-007	0.4935-007 / 0.1487-008
0.	0.	15.0	5.0	40.0	12.5	0.	27.5	0.	0.				
0	1	1	1	21	14	0	0	0	2	IDEOC	AMP	0.9700-007 / 0.1900-007	0.4850-007 / 0.1142-007
0.	2.5	2.5	2.5	52.5	35.0	0.	0.	0.	5.0				
0	0	0	17	0	15	5	2	0	1	IECOB	AMP	0.3900-007 / 0.3300-007	0.3595-007 / 0.1185-008
0.	0.	0.	42.5	0.	37.5	12.5	5.0	0.	2.5				
0	0	0	9	17	9	0	3	1	1	IEBOB	AMP	0.3130-006 / 0.4300-007	0.9113-007 / 0.9502-007
0.	0.	0.	22.5	42.5	22.5	0.	7.5	2.5	2.5				
0	0	5	5	13	6	2	8	1	0	BTACL	AMP	0.9273-004 / 0.3590-005	0.3686-004 / 0.2084-004
0.	0.	12.5	12.5	32.5	15.0	5.0	20.0	2.5	0.				
0	0	7	3	17	0	0	13	0	0	BTACW	AMP	0.2694-002 / 0.3206-003	0.1431-002 / 0.9482-003
0.	0.	17.5	7.5	42.5	0.	0.	32.5	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GD	RB18N	1318	L4054	025 C	340	XH	34

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	RARA	UNIT	MEAN VALUE / LOW VALUE	MEAN / STD
0	1	8	0	6	7	8	3	1	0	IECOT	AMP	0.3400-007 / 0.2700-007	0.3074-007 / 0.1556-008
0.	2.9	23.5	0.	17.6	20.6	23.5	8.8	2.9	0.				
0	0	0	11	12	3	1	5	2	0	IEBOT	AMP	0.2050-006 / 0.4300-007	0.5562-007 / 0.4405-007
0.	0.	0.	32.4	35.3	8.8	2.9	14.7	5.9	0.				
0	0	5	4	12	4	2	6	1	0	BTATL	AMP	0.8501-004 / 0.1074-004	0.3739-004 / 0.8001-004
0.	0.	14.7	11.8	35.3	11.8	5.9	17.6	2.9	0.				
0	0	7	1	16	2	0	8	0	0	BTATW	AMP	0.2467-002 / 0.4748-003	0.1280-002 / 0.6678-003
0.	0.	20.6	2.9	47.1	5.9	0.	23.5	0.	0.				
0	2	3	0	14	7	0	8	0	0	ICBOC	AMP	0.5100-007 / 0.4100-007	0.4647-007 / 0.2465-008
0.	5.9	8.8	0.	41.2	20.6	0.	23.5	0.	0.				
0	1	0	1	22	9	0	0	0	1	ICECC	AMP	0.9500-007 / 0.2500-007	0.4609-007 / 0.9272-008
0.	2.9	0.	2.9	64.7	26.5	0.	0.	0.	2.9				
0	0	5	3	7	12	2	4	1	0	IECOS	AMP	0.3600-007 / 0.2900-007	0.3159-007 / 0.1572-008
0.	0.	14.7	8.8	20.6	35.3	5.9	11.8	2.9	0.				
0	0	0	3	21	5	2	2	0	1	IEBOS	AMP	0.3250-006 / 0.3900-007	0.8224-007 / 0.8575-007
0.	0.	0.	8.8	61.8	14.7	5.9	5.9	0.	2.9				
0	0	5	4	12	5	1	6	1	0	BTACL	AMP	0.8367-004 / 0.9150-005	0.3900-004 / 0.1078-004
0.	0.	14.7	11.8	35.3	14.7	2.9	17.6	2.9	0.				
0	0	5	3	17	1	0	8	0	0	BTACW	AMP	0.2426-002 / 0.3812-003	0.1262-002 / 0.6515-003
0.	0.	14.7	8.8	50.0	2.9	0.	23.5	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GQ	R518N	2208	L4054	025 C	694	XH	32

*3STD	*2STD	*1STD	*.67STD	MEAN	*.67STD	*1STD	*2STD	*3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	0	15	0	14	0	2	0	1	IECOT	AMP	0.4300-007	0.4066-007
0.	0.	0.	46.9	0.	43.7	0.	6.2	0.	3.1			0.4000-007	0.9453-009
0	0	0	10	13	1	1	5	2	0	IEBOT	AMP	0.2150-006	0.7525-007
0.	0.	0.	31.2	40.6	3.1	3.1	15.6	6.2	0.			0.5200-007	0.6553-007
0	0	4	5	11	4	1	6	1	0	BTATL	AMP	0.7558-004	0.3832-004
0.	0.	12.5	15.6	34.4	12.5	3.1	18.7	3.1	0.			0.9230-005	0.1811-004
0	0	7	1	15	1	0	8	0	0	BTATH	AMP	0.2461-002	0.1291-002
0.	0.	21.9	3.1	46.9	3.1	0.	25.0	0.	0.			0.4648-003	0.6884-003
0	0	7	0	13	7	0	3	2	0	ICBOC	AMP	0.6000-007	0.5731-007
0.	0.	21.9	0.	40.6	21.9	0.	9.4	6.2	0.			0.5500-007	0.1280-006
1	0	0	0	15	15	0	0	0	1	ICEOC	AMP	0.8800-007	0.5531-007
3.1	0.	0.	0.	46.9	46.9	0.	0.	0.	3.1			0.1800-007	0.8078-008
0	0	2	0	19	0	9	0	2	0	IECOS	AMP	0.4300-007	0.4134-007
0.	0.	6.2	0.	59.4	0.	28.1	0.	6.2	0.			0.4000-007	0.9067-009
0	0	0	3	20	6	0	2	0	1	IEBOS	AMP	0.3350-006	0.9391-007
0.	0.	0.	9.4	62.5	18.7	0.	6.2	0.	3.1			0.5100-007	0.5686-007
0	0	5	5	9	5	2	5	1	0	BTACL	AMP	0.7321-004	0.3273-004
0.	0.	15.6	15.6	28.1	15.6	6.2	15.6	3.1	0.			0.1040-004	0.1752-004
0	0	5	5	13	1	0	8	0	0	BTACH	AMP	0.2413-002	0.1269-002
0.	0.	15.6	15.6	40.6	3.1	0.	25.0	0.	0.			0.4501-003	0.6624-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
60	M518N	3068	L4054	025 C	10C	XM	32

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	4	5	8	0	13	2	0	0	IECOT	0.4100-007	0.3013-007
0.	0.	12.5	15.6	25.0	0.	40.6	6.2	0.	0.		0.3700-007	0.1157-008
0	0	0	10	12	2	1	5	2	0	IEBOT	0.2130-006	0.9153-007
0.	0.	0.	31.2	37.5	6.2	3.1	15.6	6.2	0.		0.5000-007	0.4540-007
0	0	5	4	11	4	1	6	1	0	BTATLI	0.1088-003	0.4964-004
0.	0.	15.6	12.5	34.4	12.5	3.1	18.7	3.1	0.		0.1413-004	0.6675-004
0	0	7	1	15	1	0	8	0	0	BTATHI	0.2477-002	0.1303-002
0.	0.	21.9	3.1	46.9	3.1	0.	25.0	0.	0.		0.4697-003	0.6874-003
0	0	3	11	2	5	4	7	0	0	IEBOC	0.5400-007	0.5053-007
0.	0.	9.4	34.4	6.2	15.6	12.5	21.9	0.	0.		0.4700-007	0.1863-008
0	1	0	0	10	20	0	0	0	1	IEECC	0.9300-007	0.4891-007
0.	3.1	0.	0.	31.2	62.5	0.	0.	0.	3.1		0.2600-007	0.9110-008
1	0	1	0	0	28	0	1	0	1	IECOB	0.4200-007	0.4000-007
3.1	0.	3.1	0.	0.	87.5	0.	3.1	0.	3.1		0.3800-007	0.9680-009
0	0	0	4	18	6	1	2	0	1	IEBOB	0.3210-006	0.9191-007
0.	0.	0.	12.5	56.2	18.7	3.1	6.2	0.	3.1		0.5000-007	0.5516-007
0	0	5	4	10	5	1	6	1	0	BTACLI	0.1055-003	0.4879-004
0.	0.	15.6	12.5	31.2	15.6	3.1	18.7	3.1	0.		0.1588-004	0.2582-004
0	0	5	5	13	1	0	8	0	0	BTACHI	0.2424-002	0.1272-002
0.	0.	15.6	15.6	40.6	3.1	0.	25.0	0.	0.		0.4626-003	0.6649-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4054	R518N	7098	GO	025 G	400	XH	28

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	1	0	6	7	5	2	7	0	0	IEC8T	AMP	0.4000-007 / 0.2800-007	0.3571-007 / 0.2840-008
0.	3.6	0.	21.4	25.0	17.9	7.1	25.0	0.	0.				
0	0	0	8	12	1	1	4	2	0	IEBOT	AMP	0.2100-006 / 0.5300-007	0.9311-007 / 0.4624-007
0.	0.	0.	28.6	42.9	3.6	3.6	14.3	7.1	0.				
0	0	5	2	9	5	2	4	1	0	BTATL	AMP	0.7403-004 / 0.1039-004	0.3631-004 / 0.1737-004
0.	0.	17.9	7.1	32.1	17.9	7.1	14.3	3.6	0.				
0	0	5	3	11	2	0	7	0	0	BTATH	AMP	0.2308-002 / 0.4481-003	0.1272-002 / 0.6304-003
0.	0.	17.9	10.7	39.3	7.1	0.	25.0	0.	0.				
0	0	8	1	2	7	4	6	0	0	ICBOC	AMP	0.5700-007 / 0.3800-007	0.4825-007 / 0.6642-008
0.	0.	28.6	3.6	7.1	25.0	14.3	21.4	0.	0.				
0	1	2	4	9	2	3	7	0	0	ICEOC	AMP	0.5600-007 / 0.2900-007	0.4604-007 / 0.7326-008
0.	3.6	7.1	14.3	32.1	7.1	10.7	25.0	0.	0.				
1	0	0	6	10	0	7	4	0	0	IEC08	AMP	0.4200-007 / 0.3000-007	0.3807-007 / 0.2463-008
3.6	0.	0.	21.4	35.7	0.	25.0	14.3	0.	0.				
0	0	0	5	14	1	3	3	1	1	IEB08	AMP	0.1900-006 / 0.5300-007	0.8739-007 / 0.3670-007
0.	0.	0.	17.9	50.0	3.6	10.7	10.7	3.6	3.6				
0	0	5	3	8	6	1	3	2	0	BTAGL	AMP	0.7105-004 / 0.1097-004	0.3463-004 / 0.1683-004
0.	0.	17.9	10.7	28.6	21.4	3.6	10.7	7.1	0.				
0	0	5	3	11	2	0	7	0	0	BTAGH	AMP	0.2297-002 / 0.4357-003	0.1225-002 / 0.5957-003
0.	0.	17.9	10.7	39.3	7.1	0.	25.0	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
00	R-518	D287	L4054	025 C	ENV	FE	40

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	1	1	1	0	7	28	0	2	0	0			
	2.5	2.5	2.5	0.	17.5	70.0	0.	5.0	0.	0.			
IC1C2											AMPI	0.5100-007	0.4648-007
												0.2700-007	0.5929-008
	0	1	7	0	12	0	19	1	0	0			
	0.	2.5	17.5	0.	30.0	0.	47.5	2.5	0.	0.			
IC2C1											AMPI	0.4800-007	0.4630-007
												0.4400-007	0.8829-009
	0	0	0	0	34	0	0	0	6	0			
	0.	0.	0.	0.	85.0	0.	0.	0.	15.0	0.			
IC6G0											AMPI	0.1431-004	0.2240-005
												0.1050-006	0.5135-005
	0	0	4	8	14	2	1	11	0	0			
	0.	0.	10.0	20.0	35.0	5.0	2.5	27.5	0.	0.			
BTACI											AMPI	0.5532-004	0.2306-004
												0.2254-005	0.7687-004
	0	0	5	8	2	2	3	0	0	0			
	0.	0.	12.5	20.0	30.0	5.0	7.5	25.0	0.	0.			
BTATI											AMPI	0.5627-004	0.2922-004
												0.7264-005	0.7465-004
	0	0	3	11	13	0	0	13	0	0			
	0.	0.	7.5	27.5	32.5	0.	0.	32.5	0.	0.			
IDSL											AMPI	0.1639-004	0.6871-005
												0.1220-005	0.5480-005
	0	0	7	4	10	6	2	11	0	0			
	0.	0.	17.5	10.0	25.0	15.0	5.0	27.5	0.	0.			
IDSH											AMPI	0.5857-004	0.3509-004
												0.4760-005	0.7672-004
	0	1	8	3	5	14	0	9	0	0			
	0.	2.5	20.0	7.5	12.5	35.0	0.	22.5	0.	0.			
IL5											AMPI	0.1200-006	0.1158-006
												0.1110-006	0.2135-008
	0	0	5	6	11	2	9	7	0	0			
	0.	0.	12.5	15.0	27.5	5.0	22.5	17.5	0.	0.			
IL-12											AMPI	0.1070-006	0.1037-006
												0.1010-006	0.1774-008
	0	0	7	6	7	9	3	8	0	0			
	0.	0.	17.5	15.0	17.5	22.5	7.5	20.0	0.	0.			
IL-11											AMPI	0.1240-006	0.1205-006
												0.1170-006	0.2025-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
QU	H518N	1318	L4054	025 C	340	XH	34

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	1	0	6	0	8	11	4	4	0	0	IC1C2	AMP	0.4700-007	0.4185-007
	2.9	0.	17.6	0.	23.5	32.4	11.8	11.8	0.	0.			0.3300-007	0.2653-008
	0	0	3	8	9	3	3	8	0	0	IC2C1	AMP	0.4700-007	0.4509-007
	0.	0.	8.8	23.5	26.5	8.8	8.8	23.5	0.	0.			0.3900-007	0.2314-008
	0	0	0	0	8	0	0	0	6	0	IC6QQ	AMP	0.14 9-004	0. 611-005
	0.	0.	0.	0.	82.4	0.	0.	0.	17.6	0.			0.6500-007	0.5485-005
	0	0	3	7	11	5	1	5	2	0	BTACI	AMP	0.5569-004	0.1094-004
	0.	0.	8.8	20.6	32.4	14.7	2.9	14.7	5.9	0.			0.2276-005	0.1531-004
	0	0	1	10	10	5	2	4	2	0	BTATI	AMP	0.5666-004	0.2482-004
	0.	0.	2.9	29.4	29.4	14.7	5.9	11.8	5.9	0.			0.7334-005	0.1383-004
	0	0	1	8	1	1	0	6	1	0	IDSL	AMP	0.14 3-004	0.5054-005
	0.	0.	2.9	23.5	50.0	2.9	0.	17.6	2.9	0.			0.1600-006	0.4231-005
	0	0	7	2	10	6	2	7	0	0	IDSH	AMP	0.5529-004	0.2856-004
	0.	0.	20.6	5.9	29.4	17.6	5.9	20.6	0.	0.			0.4740-005	0.1549-004
	0	2	5	0	6	13	2	6	0	0	IL5	AMP	0.1190-006	0.1140-006
	0.	5.9	14.7	0.	17.6	38.2	5.9	17.6	0.	0.			0.1090-006	0.2765-008
	0	0	5	6	6	5	4	8	0	0	IL-12	AMP	0.1070-006	0.1031-006
	0.	0.	14.7	17.6	17.6	14.7	11.8	23.5	0.	0.			0.9800-007	0.2607-008
	0	0	5	1	16	1	7	4	0	0	IL-11	AMP	0.1230-006	0.1191-006
	0.	0.	14.7	2.9	47.1	2.9	20.6	11.8	0.	0.			0.1150-006	0.2074-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GQ	R518N	2208	L4054	025 C	694	XH	32

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
1	0	0	3	11	12	0	5	0	0	IC1C2	AMP	0.5700-007 / 0.4400-007	0.5466-007 / 0.2323-008
3.1	0.	0.	9.4	34.4	37.5	0.	15.6	0.	0.				
0	0	1	1	28	0	0	1	0	1	IC2C1	AMP	0.2560-006 / 0.2100-007	0.6125-007 / 0.3883-007
0.	0.	3.1	3.1	87.5	0.	0.	3.1	0.	3.1				
0	0	0	0	24	2	0	6	0	0	IC6GQ	AMP	0.1422-004 / 0.1900-007	0.3164-005 / 0.5534-005
0.	0.	0.	0.	75.0	6.2	0.	18.7	0.	0.				
0	0	3	6	11	4	1	5	2	0	BTACI	AMP	0.5556-004 / 0.2269-005	0.2048-004 / 0.1556-004
0.	0.	9.4	18.7	34.4	12.5	3.1	15.6	6.2	0.				
0	0	3	6	11	4	2	4	2	0	BTATI	AMP	0.5664-004 / 0.1196-004	0.2566-004 / 0.1325-004
0.	0.	9.4	18.7	34.4	12.5	6.2	12.5	6.2	0.				
0	0	1	8	15	1	0	6	1	0	IDSL	AMP	0.1407-004 / 0.5900-006	0.5233-005 / 0.4391-005
0.	0.	3.1	25.0	46.9	3.1	0.	18.7	3.1	0.				
0	0	7	1	9	7	1	7	0	0	IDSH	AMP	0.5521-004 / 0.4600-005	0.2856-004 / 0.1566-004
0.	0.	21.9	3.1	28.1	21.9	3.1	21.9	0.	0.				
0	1	1	8	0	13	0	8	1	0	ILB	AMP	0.1380-006 / 0.1530-006	0.1359-006 / 0.2027-008
0.	3.1	3.1	25.0	0.	40.6	0.	25.0	3.1	0.				
0	2	7	0	9	0	12	2	0	0	IL-12	AMP	0.1240-006 / 0.1200-006	0.1222-006 / 0.1051-008
0.	6.2	21.9	0.	28.1	0.	37.5	6.2	0.	0.				
1	0	3	0	7	14	0	7	0	0	IL-11	AMP	0.1420-006 / 0.1370-006	0.1407-006 / 0.1120-008
3.1	0.	9.4	0.	21.9	43.7	0.	21.9	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GD	R518N	3068	L4054	025 C	10C	XH	32

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
1	0	0	4	10	9	4	4	0	0	IC1C2	AMPI	0.5300-007 / 0.4200-007	0.4897-007 / 0.2192-008
3.1	0.	0.	12.5	31.2	28.1	12.5	12.5	0.	0.				
0	0	0	0	28	0	0	1	2	1	IC2C1	AMPI	0.9920-006 / 0.2000-007	0.1283-006 / 0.8346-006
0.	0.	0.	0.	87.5	0.	0.	3.1	6.2	3.1				
0	0	0	0	24	1	0	7	0	0	ID6GQ	AMPI	0.1423-004 / 0.3800-007	0.3457-005 / 0.5541-005
0.	0.	0.	0.	75.0	3.1	0.	21.9	0.	0.				
0	0	3	6	11	4	1	5	2	0	BTADI	AMPI	0.5568-004 / 0.2283-005	0.2053-004 / 0.1560-004
0.	0.	9.4	18.7	34.4	12.5	3.1	15.6	6.2	0.				
0	0	3	6	11	4	2	4	2	0	BTATI	AMPI	0.5682-004 / 0.1203-004	0.2574-004 / 0.1329-004
0.	0.	9.4	18.7	34.4	12.5	6.2	12.5	6.2	0.				
0	0	1	6	16	2	0	6	1	0	IDSLI	AMPI	0.1529-004 / 0.7300-006	0.5423-005 / 0.4938-005
0.	0.	3.1	18.7	50.0	6.2	0.	18.7	3.1	0.				
0	0	7	2	8	6	2	7	0	0	IDSH	AMPI	0.5522-004 / 0.4700-005	0.2879-004 / 0.1595-004
0.	0.	21.9	6.2	25.0	18.7	6.2	21.9	0.	0.				
0	1	0	10	0	14	2	5	0	0	ILB	AMPI	0.1230-006 / 0.1180-004	0.1210-006 / 0.1150-006
0.	3.1	0.	31.2	0.	43.7	6.2	15.6	0.	0.				
0	0	4	5	8	6	0	9	0	0	IL-12	AMPI	0.1070-006 / 0.1030-006	0.1053-006 / 0.1382-006
0.	0.	12.5	15.6	25.0	18.7	0.	28.1	0.	0.				
0	2	5	0	12	7	0	6	0	0	IL-11	AMPI	0.1270-006 / 0.1230-006	0.1253-006 / 0.1148-006
0.	6.2	15.6	0.	37.5	21.9	0.	18.7	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4054	R518N	7898	GO	825 C	400	XH	28

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD		PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	7	3	2	5	3	8	0	0	IC1C2	AMP	0.5300-007	0.4654-007
0.	0.	25.0	10.7	7.1	17.9	10.7	28.6	0.	0.			0.3500-007	0.6304-008
0	0	0	0	23	1	0	1	3	0	IC2C1	AMP	0.8800-006	0.1533-006
0.	0.	0.	0.	82.1	3.6	0.	3.6	10.7	0.			0.3400-007	0.2618-006
0	0	0	13	4	2	0	9	0	0	IC6G0	AMP	0.1499-004	0.5599-005
0.	0.	0.	46.4	14.3	7.1	0.	32.1	0.	0.			0.6500-007	0.6462-005
0	0	2	5	10	4	1	5	1	0	BTAGI	AMP	0.5103-004	0.1943-004
0.	0.	7.1	17.9	35.7	14.3	3.6	17.9	3.6	0.			0.2531-005	0.1383-004
0	0	5	2	10	4	2	4	1	0	BTATI	AMP	0.5242-004	0.2439-004
0.	0.	17.9	7.1	35.7	14.3	7.1	14.3	3.6	0.			0.1121-004	0.1162-004
0	0	1	6	14	1	0	5	1	0	IDSL	AMP	0.1504-004	0.5218-005
0.	0.	3.6	21.4	50.0	3.6	0.	17.9	3.6	0.			0.	0.4331-005
0	0	6	2	8	5	1	6	0	0	IDSH	AMP	0.5416-004	0.2796-004
0.	0.	21.4	7.1	28.6	17.9	3.6	21.4	0.	0.			0.4880-005	0.1592-004
0	0	4	5	5	4	4	6	0	0	IL5	AMP	0.1000-006	0.9057-007
0.	0.	14.3	17.9	17.9	14.3	14.3	21.4	0.	0.			0.6900-007	0.1079-007
0	1	6	2	4	5	5	5	0	0	IL-12	AMP	0.9500-007	0.7936-007
0.	3.6	21.4	7.1	14.3	17.9	17.9	17.9	0.	0.			0.5600-007	0.1120-007
0	1	4	4	6	3	4	6	0	0	IL-11	AMP	0.1140-006	0.9621-007
0.	3.6	14.3	14.3	21.4	10.7	14.3	21.4	0.	0.			0.7300-007	0.1096-007

FAMILY	TYPE	DATE	TEST NO.	TEMP.	TIME	TEST	SET SIZE
UQ3	R-P18	D287	L4054	025 C	ENV	FE	12

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	3	0	0	8	1	0	0	0	IRQ09	AMP	0.4700-007 / 0.3925-007
0.	0.	25.0	0.	0.	66.7	8.3	0.	0.	0.		0.2000-007	0.1016-007
0	0	0	5	0	4	0	2	1	0	IQR04	AMP	0.5000-007 / 0.4792-007
0.	0.	0.	41.7	0.	33.3	0.	16.7	8.3	0.		0.4700-007	0.9942-009
0	0	3	0	1	5	1	2	0	0	IBR04	AMP	0.5100-007 / 0.4883-007
0.	0.	25.0	0.	8.3	41.7	8.3	16.7	0.	0.		0.4700-007	0.1403-008
1	0	0	0	1	10	0	0	0	0	IRB02	AMP	0.4800-007 / 0.4425-007
8.3	0.	0.	0.	8.3	83.3	0.	0.	0.	0.		0.2700-007	0.5594-008
0	0	0	6	0	3	0	3	0	0	IQB02	AMP	0.4900-007 / 0.477 -007
0.	0.	0.	50.0	0.	25.0	0.	25.0	0.	0.		0.4700-007	0.8460-009
0	0	4	0	3	0	4	1	0	0	IBQ09	AMP	0.4800-007 / 0.4617-007
0.	0.	33.3	0.	25.0	0.	33.3	8.3	0.	0.		0.4500-007	0.1030-008
0	1	0	0	0	10	0	1	0	0	IRC01	AMP	0.5100-007 / 0.4900-007
0.	8.3	0.	0.	0.	83.3	0.	8.3	0.	0.		0.3600-007	0.8668-008
0	0	3	0	4	0	5	0	0	0	ICB01	AMP	0.4900-007 / 0.4817-007
0.	0.	25.0	0.	33.3	0.	41.7	0.	0.	0.		0.4700-007	0.8348-009
0	0	1	0	5	3	1	2	0	0	ICQ01	AMP	0.5000-007 / 0.4975-007
0.	0.	8.3	0.	41.7	25.0	8.3	16.7	0.	0.		0.4500-007	0.1422-008
0	0	0	0	11	0	0	0	0	1	ICE01	AMP	0.3840-006 / 0.7608-007
0.	0.	0.	0.	91.7	0.	0.	0.	0.	8.3		0.4300-007	0.9711-007

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UGS	M518N	1318	L4054	025 C	340	XH	11

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0 / 0.	0 / 0.	0 / 0.	4 / 36.4	4 / 36.4	1 / 9.1	1 / 9.1	0 / 0.	1 / 9.1	0 / 0.	IRQ09	AMP	0.4800-007 / 0.3900-007	0.4127-007 / 0.2796-008
0 / 0.	0 / 0.	3 / 27.3	0 / 0.	3 / 27.3	2 / 18.2	0 / 0.	3 / 27.3	0 / 0.	0 / 0.	IQR04	AMP	0.4600-007 / 0.4000-007	0.4355-007 / 0.2267-008
0 / 0.	1 / 9.1	0 / 0.	1 / 9.1	4 / 36.4	2 / 18.2	1 / 9.1	2 / 18.2	0 / 0.	0 / 0.	IBR04	AMP	0.4900-007 / 0.3900-007	0.4545-007 / 0.2911-008
0 / 0.	1 / 9.1	0 / 0.	2 / 18.2	1 / 9.1	5 / 45.5	1 / 9.1	1 / 9.1	0 / 0.	0 / 0.	IRB02	AMP	0.4800-007 / 0.3300-007	0.4509-007 / 0.4437-008
0 / 0.	1 / 9.1	1 / 9.1	0 / 0.	1 / 9.1	6 / 54.5	0 / 0.	2 / 18.2	0 / 0.	0 / 0.	IQB02	AMP	0.4800-007 / 0.4100-007	0.4573-007 / 0.2102-008
0 / 0.	0 / 0.	2 / 18.2	2 / 18.2	1 / 9.1	5 / 45.5	0 / 0.	0 / 0.	1 / 9.1	0 / 0.	IBQ09	AMP	0.4900-007 / 0.4300-007	0.4527-007 / 0.1737-008
0 / 0.	0 / 0.	1 / 9.1	2 / 18.2	2 / 18.2	2 / 18.2	3 / 27.3	1 / 9.1	0 / 0.	0 / 0.	IRC01	AMP	0.4800-007 / 0.3900-007	0.4282-007 / 0.2822-008
0 / 0.	0 / 0.	3 / 27.3	0 / 0.	3 / 27.3	3 / 27.3	0 / 0.	2 / 18.2	0 / 0.	0 / 0.	ICB01	AMP	0.4900-007 / 0.4300-007	0.4609-007 / 0.1614-008
0 / 0.	1 / 9.1	1 / 9.1	0 / 0.	2 / 18.2	5 / 45.5	1 / 9.1	1 / 9.1	0 / 0.	0 / 0.	ICQ01	MP	0.4800-007 / 0.3900-007	0.4509-007 / 0.2508-008
0 / 0.	0 / 0.	0 / 0.	0 / 0.	10 / 90.9	0 / 0.	0 / 0.	0 / 0.	0 / 0.	1 / 9.1	ICE01	AMP	0.3550-006 / 0.3500-007	0.7118-007 / 0.9420-007

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UGS	R518N	2208	L4054	029 0	694	XH	11

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	2	0	4	3	0	2	0	0	IRQ09	AMP	0.9700-007 / 0.5500-007	0.9056-007 / 0.1296-008
0.	0.	18.2	0.	36.4	27.3	0.	18.2	0.	0.				
0	0	2	0	5	2	0	2	0	0	IRR04	AMP	0.9800-007 / 0.5400-007	0.9687-007 / 0.1191-008
0.	0.	18.2	0.	45.5	18.2	0.	18.2	0.	0.				
0	0	1	2	0	6	0	1	1	0	IBR04	AMP	0.9900-007 / 0.5500-007	0.9891-007 / 0.1044-008
0.	0.	9.1	18.2	0.	54.5	0.	9.1	9.1	0.				
0	1	0	0	1	9	0	0	0	0	IRB02	AMP	0.9700-007 / 0.4400-007	0.9518-007 / 0.1763-008
0.	9.1	0.	0.	9.1	81.8	0.	0.	0.	0.				
0	0	2	0	2	4	0	3	0	0	IQB02	AMP	0.9800-007 / 0.5500-007	0.9673-007 / 0.1164-008
0.	0.	18.2	0.	18.2	36.4	0.	27.3	0.	0.				
0	0	4	0	3	0	0	4	0	0	IBQ09	AMP	0.9700-007 / 0.5500-007	0.9600-007 / 0.9964-009
0.	0.	36.4	0.	27.3	0.	0.	36.4	0.	0.				
0	1	0	0	4	4	2	0	0	0	IRC01	AMP	0.9800-007 / 0.4900-007	0.9609-007 / 0.8468-008
0.	9.1	0.	0.	36.4	36.4	18.2	0.	0.	0.				
0	0	2	0	0	6	0	3	0	0	ICB01	AMP	0.9800-007 / 0.5500-007	0.9694-007 / 0.2044-008
0.	0.	18.2	0.	0.	54.5	0.	27.3	0.	0.				
0	1	0	1	4	4	0	1	0	0	IDQ01	AMP	0.9900-007 / 0.5500-007	0.9827-007 / 0.1469-008
0.	9.1	0.	9.1	36.4	36.4	0.	9.1	0.	0.				
0	0	0	0	10	0	0	0	0	1	IDE01	AMP	0.3500-006 / 0.5100-007	0.9855-007 / 0.8158-007
0.	0.	0.	0.	90.9	0.	0.	0.	0.	9.1				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UQS	RB18N	3068	L4054	029 0	10C	XH	11

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	1	0	1	0	8	1	0	0	0	IRQ09	AMPI	0.5000-007 / 0.3900-007	0.4755-007 / 0.3110-008
	0.	9.1	0.	9.1	0.	72.7	9.1	0.	0.	0.			
	0	1	0	0	8	0	0	2	0	0	IQR04	AMPI	0.4800-007 / 0.4600-007	0.4707-007 / 0.5394-009
	0.	9.1	0.	0.	72.7	0.	0.	18.2	0.	0.			
	0	0	0	5	1	0	4	1	0	0	IRR04	AMPI	0.5000-007 / 0.4700-007	0.4809-007 / 0.2136-008
	0.	0.	0.	45.5	9.1	0.	36.4	9.1	0.	0.			
	0	1	0	0	0	7	3	0	0	0	IRB02	AMPI	0.4900-007 / 0.3900-007	0.4700-007 / 0.2795-008
	0.	9.1	0.	0.	0.	63.6	27.3	0.	0.	0.			
	0	0	2	0	7	0	0	1	1	0	IQB02	AMPI	0.5100-007 / 0.4800-007	0.4909-007 / 0.3312-009
	0.	0.	18.2	0.	63.6	0.	0.	9.1	9.1	0.			
	0	0	1	0	6	1	0	3	0	0	IBQ09	AMPI	0.5100-007 / 0.4800-007	0.4955-007 / 0.1036-008
	0.	0.	9.1	0.	54.5	9.1	0.	27.3	0.	0.			
	0	1	0	0	0	9	1	0	0	0	IRC01	AMPI	0.5300-007 / 0.4300-007	0.5091-007 / 0.8700-008
	0.	9.1	0.	0.	0.	81.8	9.1	0.	0.	0.			
	0	1	0	0	4	3	0	3	0	0	IQB01	AMPI	0.5300-007 / 0.4900-007	0.5164-007 / 0.1286-008
	0.	9.1	0.	0.	36.4	27.3	0.	27.3	0.	0.			
	0	1	2	0	0	7	0	1	0	0	IQQ01	AMPI	0.5500-007 / 0.4700-007	0.5082-007 / 0.1799-008
	0.	9.1	18.2	0.	0.	63.6	0.	9.1	0.	0.			
	0	0	0	0	10	0	0	0	0	1	IQE01	AMPI	0.3600-006 / 0.4300-007	0.7727-007 / 0.9380-007
	0.	0.	0.	0.	90.9	0.	0.	0.	0.	9.1			

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4054	R51BN	7808	UGS	025 G	400	XH	11

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	1	0	0	4	5	0	1	0	0	IRG09	AMP	0.5900-007 / 0.4630-007
0.	9.1	0.	0.	36.4	45.5	0.	9.1	0.	0.			0.2800-007 / 0.8028-008
0	0	2	2	1	1	4	1	0	0	IGR04	AMP	0.5400-007 / 0.4934-007
0.	0.	18.2	18.2	9.1	9.1	36.4	9.1	0.	0.			0.4300-007 / 0.4032-008
0	0	2	2	1	2	1	3	0	0	IBR04	AMP	0.5500-007 / 0.5000-007
0.	0.	18.2	18.2	9.1	18.2	9.1	27.3	0.	0.			0.4300-007 / 0.3975-008
0	1	0	0	5	1	3	1	0	0	IRB02	AMP	0.5700-007 / 0.4980-007
0.	9.1	0.	0.	45.5	9.1	27.3	9.1	0.	0.			0.3600-007 / 0.6400-008
0	0	3	0	2	2	3	1	0	0	IGB02	AMP	0.5700-007 / 0.5180-007
0.	0.	27.3	0.	18.2	18.2	27.3	9.1	0.	0.			0.4600-007 / 0.4262-008
0	0	2	3	0	0	4	2	0	0	IBG09	AMP	0.5300-007 / 0.4891-007
0.	0.	18.2	27.3	0.	0.	36.4	18.2	0.	0.			0.4300-007 / 0.4036-008
0	1	0	2	2	4	1	1	0	0	IRC01	AMP	0.6000-007 / 0.5236-007
0.	9.1	0.	18.2	18.2	36.4	9.1	9.1	0.	0.			0.4000-007 / 0.6038-008
0	0	2	3	0	2	3	1	0	0	ICB01	AMP	0.6000-007 / 0.5534-007
0.	0.	18.2	27.3	0.	18.2	27.3	9.1	0.	0.			0.4600-007 / 0.4965-008
0	0	3	0	2	1	4	1	0	0	ICG01	AMP	0.6000-007 / 0.5327-007
0.	0.	27.3	0.	18.2	9.1	36.4	9.1	0.	0.			0.4600-007 / 0.5274-008
0	0	0	0	10	0	0	0	0	1	ICE01	AMP	0.3900-006 / 0.8110-007
0.	0.	0.	0.	90.9	0.	0.	0.	0.	9.1			0.4100-007 / 0.1036-006

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SAT SIZE
U08	R-518	D287	L4054	025 C	ENV	FE	12

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	MEAN VALUE LOW VALUE	MEAN STD
0	0	0	6	0	3	0	2	1	0	IECOT	AMP	0.3500-007
0.	0.	0.	50.0	0.	25.0	0.	16.7	8.3	0.		0.3200-007	0.1050-008
0	0	0	3	5	2	0	1	1	0	IEBOT	AMP	0.1650-006
0.	0.	0.	25.0	41.7	16.7	0.	8.3	8.3	0.		0.4900-007	0.8565-007
0	0	0	0	9	1	0	1	1	0	BTATLI	AMP	0.2037-003
0.	0.	0.	0.	75.0	8.3	0.	8.3	8.3	0.		0.1351-004	0.6260-004
0	0	0	1	9	0	0	1	1	0	BTATMI	AMP	0.3903-002
0.	0.	0.	8.3	75.0	0.	0.	8.3	8.3	0.		0.5889-003	0.1098-002
0	0	1	1	5	4	0	0	1	0	I BO	AMP	0.5500-007
0.	0.	8.3	8.3	41.7	33.3	0.	0.	8.3	0.		0.4600-007	0.8067-008
0	0	0	0	11	0	0	0	0	1	IDEOO	AMP	0.7950-006
0.	0.	0.	0.	91.7	0.	0.	0.	0.	8.3		0.2100-007	0.8162-006
0	0	0	0	7	2	1	1	1	0	IEOOB	AMP	0.3700-007
0.	0.	0.	0.	58.3	16.7	8.3	8.3	8.3	0.		0.3300-007	0.2379-008
0	0	0	0	9	1	1	0	1	0	IEBOB	AMP	0.5380-006
0.	0.	0.	0.	75.0	8.3	8.3	0.	8.3	0.		0.4500-007	0.1400-006
0	0	0	1	8	1	0	1	1	0	BTAOLI	AMP	0.1499-003
0.	0.	0.	8.3	66.7	8.3	0.	8.3	8.3	0.		0.1526-004	0.4179-004
0	0	0	1	8	1	0	1	1	0	BTAOMI	AMP	0.3503-002
0.	0.	0.	8.3	66.7	8.3	0.	8.3	8.3	0.		0.7125-003	0.8189-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UQS	RS18N	1318	L4054	025 C	340	XH	11

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	1	4	0	1	4	1	0	0	IEDOT	AMP	0.3300-007 / 0.2700-007	0.3049-007 / 0.1916-008
0.	0.	9.1	36.4	0.	9.1	36.4	9.1	0.	0.				
0	0	0	3	5	1	1	0	1	0	IEBOT	AMP	0.1270-006 / 0.4900-007	0.9664-007 / 0.8280-007
0.	0.	0.	27.3	45.5	9.1	9.1	0.	9.1	0.				
0	0	0	0	9	1	0	0	1	0	BTATL	AMP	0.2194-003 / 0.1469-004	0.4460-004 / 0.8790-004
0.	0.	0.	0.	81.8	9.1	0.	0.	9.1	0.				
0	0	0	1	7	2	0	0	1	0	BTATH	AMP	0.3760-002 / 0.5833-003	0.1227-002 / 0.8719-003
0.	0.	0.	9.1	63.6	18.2	0.	0.	9.1	0.				
0	1	1	0	0	6	2	1	0	0	ICBOD	AMP	0.4900-007 / 0.4100-007	0.4591-007 / 0.8427-008
0.	9.1	9.1	0.	0.	54.5	18.2	9.1	0.	0.				
0	1	0	0	1	9	0	0	0	0	CEDO	AMP	0.4800-007 / 0.1900-007	0.4864-007 / 0.8103-008
0.	9.1	0.	0.	9.1	81.8	0.	0.	0.	0.				
0	0	2	1	1	5	0	2	0	0	IECOD	AMP	0.3600-007 / 0.2900-007	0.3255-007 / 0.8018-008
0.	0.	18.2	9.1	9.1	45.5	0.	18.2	0.	0.				
0	0	0	0	9	0	1	0	1	0	IEBOD	AMP	0.5390-006 / 0.4400-007	0.1856-006 / 0.8476-006
0.	0.	0.	0.	81.8	0.	9.1	0.	9.1	0.				
0	0	0	0	9	1	0	0	1	0	BTACL	AMP	0.1559-003 / 0.1696-004	0.4147-004 / 0.8902-004
0.	0.	0.	0.	81.8	9.1	0.	0.	9.1	0.				
0	0	0	1	7	2	0	0	1	0	BTACH	AMP	0.3395-002 / 0.7029-003	0.1861-002 / 0.8582-003
0.	0.	0.	9.1	63.6	18.2	0.	0.	9.1	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UGB	R518N	2208	L4054	025 C	694	XH	11

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	RARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	0	1	0	6	2	0	1	1	0	IECOT	AMP	0.4300-007	0.4055-007
	0.	0.	9.1	0.	54.5	18.2	0.	9.1	9.1	0.			0.3900-007	0.1128-008
	0	0	0	3	5	1	1	0	1	0	IEBOT	AMP	0.1320-006	0.7491-007
	0.	0.	0.	27.3	45.5	9.1	9.1	0.	9.1	0.			0.5500-007	0.2207-007
	0	0	0	0	9	1	0	0	1	0	BTATL	AMP	0.1931-003	0.3984-004
	0.	0.	0.	0.	81.8	9.1	0.	0.	9.1	0.			0.1389-004	0.5189-004
	0	0	0	1	7	2	0	0	1	0	BTATW	AMP	0.3797-002	0.1221-002
	0.	0.	0.	9.1	63.6	18.2	0.	0.	9.1	0.			0.5814-003	0.8724-003
	0	0	1	0	6	2	0	1	1	0	ICBOC	AMP	0.6000-007	0.5955-007
	0.	0.	9.1	0.	54.5	18.2	0.	9.1	9.1	0.			0.5600-007	0.1128-008
	0	1	0	0	0	10	0	0	0	0	ICEOC	AMP	0.5900-007	0.5464-007
	0.	9.1	0.	0.	0.	90.9	0.	0.	0.	0.			0.2700-007	0.9233-008
	0	0	1	0	5	4	0	1	0	0	IECOB	AMP	0.4300-007	0.4145-007
	0.	0.	9.1	0.	45.5	36.4	0.	9.1	0.	0.			0.4000-007	0.8202-009
	0	0	0	0	9	0	1	0	1	0	IEBOB	AMP	0.5580-006	0.1327-006
	0.	0.	0.	0.	81.8	0.	9.1	0.	9.1	0.			0.5100-007	0.1505-006
	0	0	0	0	9	1	0	0	1	0	BTACL	AMP	0.1250-003	0.3558-004
	0.	0.	0.	0.	81.8	9.1	0.	0.	9.1	0.			0.1492-004	0.5125-004
	0	0	0	1	7	2	0	0	1	0	BTACW	AMP	0.3270-002	0.1241-002
	0.	0.	0.	9.1	63.6	18.2	0.	0.	9.1	0.			0.6925-003	0.9043-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UUS	R518N	3068	L4054	025 C	10C	XH	11

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	1	1	0	5	0	3	1	0	0	IECOT	AMP	0.4100-007 / 0.3700-007	0.3910-007 / 0.2099-008
0.	9.1	9.1	0.	45.5	0.	27.3	9.1	0.	0.				
0	0	0	3	5	1	1	0	1	0	IEBOT	AMP	0.1340-006 / 0.5600-007	0.7455-007 / 0.2254-007
0.	0.	0.	27.3	45.5	9.1	9.1	0.	9.1	0.				
0	0	0	0	9	1	0	0	1	0	BTATL	AMP	0.3309-003 / 0.2071-004	0.9325-004 / 0.8995-004
0.	0.	0.	0.	81.8	9.1	0.	0.	9.1	0.				
0	0	0	1	7	2	0	0	1	0	BTATM	AMP	0.3772-002 / 0.5898-003	0.1231-002 / 0.6741-003
0.	0.	0.	9.1	63.6	18.2	0.	0.	9.1	0.				
0	0	0	2	5	3	0	0	1	0	ICBOC	AMP	0.5700-007 / 0.4800-007	0.5036-007 / 0.2541-008
0.	0.	0.	18.2	45.5	27.3	0.	0.	9.1	0.				
1	0	0	0	0	10	0	0	0	0	ICEOC	AMP	0.5100-007 / 0.2100-007	0.4709-007 / 0.8689-008
9.1	0.	0.	0.	0.	90.9	0.	0.	0.	0.				
0	1	0	0	8	0	0	2	0	0	IECOS	AMP	0.4100-007 / 0.3900-007	0.4009-007 / 0.9394-009
0.	9.1	0.	0.	72.7	0.	0.	18.2	0.	0.				
0	0	0	0	9	0	1	0	1	0	IEBOS	AMP	0.5580-006 / 0.5100-007	0.1313-006 / 0.2507-006
0.	0.	0.	0.	81.8	0.	9.1	0.	9.1	0.				
0	0	0	1	8	1	0	0	1	0	BTACL	AMP	0.1732-003 / 0.2302-004	0.5211-004 / 0.6234-004
0.	0.	0.	9.1	72.7	9.1	0.	0.	9.1	0.				
0	0	0	1	7	2	0	0	1	0	BTACM	AMP	0.3244-002 / .7 1 - 3	0.1246-002 / .6944- 3
.	.	.	9.1	63.6	18.2	.	.	9.1	.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4054	R518N	7098	UGS	025 G	400	XH	11

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	3	0	2	2	2	2	0	0	IEGOT	AMP	0.3900-007 / 0.3627-007
0.	0.	27.3	0.	18.2	18.2	18.2	18.2	0.	0.			0.3300-007 / 0.2149-008
0	0	0	2	5	2	1	0	1	0	IEBOT	AMP	0.1370-006 / 0.7391-007
0.	0.	0.	18.2	45.5	18.2	9.1	0.	9.1	0.			0.5200-007 / 0.2409-007
0	0	0	0	9	1	0	0	1	0	BTATL	AMP	0.1872-003 / 0.4253-004
0.	0.	0.	0.	81.8	9.1	0.	0.	9.1	0.			0.1446-004 / 0.4963-004
0	0	0	1	7	2	0	0	1	0	BTATH	AMP	0.3548-002 / 0.1203-002
0.	0.	0.	9.1	63.6	18.2	0.	0.	9.1	0.			0.5619-003 / 0.8179-003
0	0	3	1	0	2	3	2	0	0	ICBOC	AMP	0.5800-007 / 0.5273-007
0.	0.	27.3	9.1	0.	18.2	27.3	18.2	0.	0.			0.4600-007 / 0.4628-008
0	1	0	0	4	5	1	0	0	0	ICEOC	AMP	0.5700-007 / 0.4873-007
0.	9.1	0.	0.	36.4	45.5	9.1	0.	0.	0.			0.1400-007 / 0.1224-007
0	0	4	0	1	4	0	2	0	0	IEGOB	AMP	0.4200-007 / 0.3909-007
0.	0.	36.4	0.	9.1	36.4	0.	18.2	0.	0.			0.3700-007 / 0.1814-008
0	0	0	0	9	0	1	0	1	0	IEBOB	AMP	0.5620-006 / 0.1332-006
0.	0.	0.	0.	81.8	0.	9.1	0.	9.1	0.			0.5400-007 / 0.1520-006
0	0	0	2	7	0	1	0	1	0	BTAGL	AMP	0.1081-003 / 0.3689-004
0.	0.	0.	18.2	63.6	0.	9.1	0.	9.1	0.			0.1465-004 / 0.2642-004
0	0	0	1	7	2	0	0	1	0	BTAGH	AMP	0.2922-002 / 0.1196-002
0.	0.	0.	9.1	63.6	18.2	0.	0.	9.1	0.			0.6377-003 / 0.6299-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
U08	R-518	D287	L4054	025 C	ENV	FE	12

-3STD	-2STD	-1STD	-.675STD	MEAN	+.675STD	+1STD	+2STD	+3STD	PARA	UNIT	MEAN VALUE LOW VALUE	MEAN VALUE STD
0	0	2	0	4	4	0	1	1	0	IC1CE:	AMP:	0.5500-007
0.	0.	16.7	0.	33.3	33.3	0.	8.3	8.3	0.			0.4400-007
0	2	0	0	0	10	0	0	0	0	IC2CL:	AMP:	0.4800-007
0.	16.7	0.	0.	0.	83.3	0.	0.	0.	0.			0.3300-007
0	0	0	0	10	0	0	0	2	0	IC6GQ:	AMP:	0.1431-004
0.	0.	0.	0.	83.3	0.	0.	0.	16.7	0.			0.9200-007
0	0	0	2	7	1	0	1	1	0	STACE:	AMP:	0.5481-004
0.	0.	0.	16.7	58.3	8.3	0.	8.3	8.3	0.			0.6791-005
0	0	2	0	6	2	0	2	0	0	STATX:	AMP:	0.4205-004
0.	0.	16.7	0.	50.0	16.7	0.	16.7	0.	0.			0.6457-005
0	0	0	0	9	1	0	1	1	0	IDSL:	AMP:	0.7249-004
0.	0.	0.	0.	75.0	8.3	0.	8.3	8.3	0.			0.1760-005
0	0	1	2	4	2	0	3	0	0	IDSH	AMP:	0.9050-004
0.	0.	8.3	16.7	33.3	16.7	0.	25.0	0.	0.			0.4770-005
0	0	0	0	11	0	0	0	0	1	ILB	AMP:	0.7810-004
0.	0.	0.	0.	91.7	0.	0.	0.	0.	8.3			0.1150-004
0	0	2	0	6	0	2	2	0	0	IL-12:	AMP:	0.1050-004
0.	0.	16.7	0.	50.0	0.	16.7	16.7	0.	0.			0.1020-004
0	0	1	2	3	5	0	0	1	0	IL-11:	AMP:	0.1860-004
0.	0.	8.3	16.7	25.0	41.7	0.	0.	8.3	0.			0.1170-004

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UGS	R518N	1318	L4054	025 C	340	XH	11

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	BARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	1	2	4	2	1	0	1	0	IC1C2	AMP	0.5100-007	0.4264-007
0.	0.	9.1	18.2	36.4	18.2	9.1	0.	9.1	0.			0.3900-007	0.8472-008
0	1	0	1	3	2	3	1	0	0	IC2C1	AMP	0.4800-007	0.4255-007
0.	9.1	0.	9.1	27.3	18.2	27.3	9.1	0.	0.			0.3300-007	0.4228-008
0	0	0	0	9	0	0	0	2	0	IC6G0	AMP	0.1428-004	0.2685-005
0.	0.	0.	0.	81.8	0.	0.	0.	18.2	0.			0.1030-006	0.5733-005
0	0	0	2	5	3	0	0	1	0	BTADI	AMP	0.5482-004	0.1798-004
0.	0.	0.	18.2	45.5	27.3	0.	0.	9.1	0.			0.6801-005	0.1327-004
0	0	2	0	5	3	0	0	1	0	BTATI	AMP	0.6219-004	0.2425-004
0.	0.	18.2	0.	45.5	27.3	0.	0.	9.1	0.			0.6503-005	0.1463-004
0	0	0	0	9	1	0	0	1	0	IDSL	AMP	0.7105-004	0.1054-004
0.	0.	0.	0.	81.8	9.1	0.	0.	9.1	0.			0.1950-005	0.8043-004
0	0	0	3	4	2	0	1	1	0	IDSH	AMP	0.8769-004	0.3804-004
0.	0.	0.	27.3	36.4	18.2	0.	9.1	9.1	0.			0.1161-004	0.8333-004
0	0	0	0	10	0	0	0	0	1	IL5	AMP	0.6240-006	0.1625-006
0.	0.	0.	0.	90.9	0.	0.	0.	0.	9.1			0.1110-006	0.1531-006
0	0	2	1	1	3	3	1	0	0	IL-12	AMP	0.1090-006	0.1053-006
0.	0.	18.2	9.1	9.1	27.3	27.3	9.1	0.	0.			0.9900-007	0.8197-008
0	0	2	1	2	4	1	0	1	0	IL-11	AMP	0.1260-006	0.1210-006
0.	0.	18.2	9.1	18.2	36.4	9.1	0.	9.1	0.			0.1180-006	0.8366-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
UGS	R518N	2208	L4054	025 C	694	XH	11

*3STD	*2STD	-1STD	*.67STD	MEAN	*.67STD	*1STD	*2STD	*3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	1	1	0	3	3	3	0	0	0	IC1C2	AMP	0.5800-007	0.5618-007
0.	9.1	9.1	0.	27.3	27.3	27.3	0.	0.	0.			0.5100-007	0.2089-008
0	1	0	0	1	9	0	0	0	0	IC2C1	AMP	0.5600-007	0.5391-007
0.	9.1	0.	0.	9.1	81.8	0.	0.	0.	0.			0.4200-007	0.4036-008
0	0	0	0	9	0	0	0	2	0	IC6GC	AMP	0.1422-004	0.2692-005
0.	0.	0.	0.	81.8	0.	0.	0.	18.2	0.			0.1280-004	0.5700-005
0	0	0	2	5	3	0	0	1	0	STACE	AMP	0.5468-004	0.1795-004
0.	0.	0.	18.2	45.5	27.3	0.	0.	9.1	0.			0.6791-005	0.1322-004
0	0	2	0	5	3	0	0	1	0	STATI	AMP	0.6225-004	0.2423-004
0.	0.	18.2	0.	45.5	27.3	0.	0.	9.1	0.			0.6492-005	0.1465-004
0	0	0	0	9	1	0	0	1	0	IDSL	AMP	0.7184-004	0.1051-004
0.	0.	0.	0.	81.8	9.1	0.	0.	9.1	0.			0.1828-005	0.2070-004
0	0	0	2	5	2	0	1	1	0	IDSH	AMP	0.8829-004	0.3351-004
0.	0.	0.	18.2	45.5	18.2	0.	9.1	9.1	0.			0.1217-004	0.2321-004
0	0	0	0	10	0	0	0	0	1	IL5	AMP	0.5990-006	0.1779-006
0.	0.	0.	0.	90.9	0.	0.	0.	0.	9.1			0.1538-006	0.1397-006
0	1	0	0	4	0	6	0	0	0	IL-12	AMP	0.1250-006	0.1225-006
0.	9.1	0.	0.	36.4	0.	54.5	0.	0.	0.			0.1210-006	0.6876-009
0	0	1	0	4	5	0	0	1	0	IL-11	AMP	0.1430-006	0.1406-006
0.	0.	9.1	0.	36.4	45.5	0.	0.	9.1	0.			0.1390-006	0.1027-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
U2B	R518N	3068	L4054	025 C	10C	XH	11

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	2	0	4	3	1	0	1	0	IC1C2	AMP	0.5600-007	0.5055-007
0.	0.	18.2	0.	36.4	27.3	9.1	0.	9.1	0.			0.4700-007	0.2505-008
0	1	0	0	6	1	2	1	0	0	IC2C1	AMP	0.5000-007	0.4718-007
0.	9.1	0.	0.	54.5	9.1	18.2	9.1	0.	0.			0.4100-007	0.2316-008
0	0	0	0	9	0	0	0	2	0	IC6GC	AMP	0.1423-004	0.2681-005
0.	0.	0.	0.	81.8	0.	0.	0.	18.2	0.			0.1130-004	0.5710-005
0	0	0	2	5	3	0	0	1	0	STACI	AMP	0.5455-004	0.1799-004
0.	0.	0.	18.2	45.5	27.3	0.	0.	9.1	0.			0.6827-005	0.1519-004
0	0	2	0	5	3	0	0	1	0	STATI	AMP	0.6226-004	0.2429-004
0.	0.	18.2	0.	45.5	27.3	0.	0.	9.1	0.			0.6526-005	0.1464-004
0	0	0	0	9	1	0	0	1	0	IDSL	AMP	0.7239-004	0.1065-004
0.	0.	0.	0.	81.8	9.1	0.	0.	9.1	0.			0.1750-005	0.2082-004
0	0	0	3	4	2	0	1	1	0	IDSH	AMP	0.8873-004	0.3375-004
0.	0.	0.	27.3	36.4	18.2	0.	9.1	9.1	0.			0.1251-004	0.2335-004
0	0	0	0	10	0	0	0	0	1	IL5	AMP	0.5950-006	0.1639-006
0.	0.	0.	0.	90.9	0.	0.	0.	0.	9.1			0.1180-006	0.1480-006
0	0	2	0	3	4	0	2	0	0	IL-12	AMP	0.1070-006	0.1054-006
0.	0.	18.2	0.	27.3	36.4	0.	18.2	0.	0.			0.1030-006	0.1362-008
0	1	0	0	6	0	3	1	0	0	IL-11	AMP	0.1270-006	0.1253-006
0.	9.1	0.	0.	54.5	0.	27.3	9.1	0.	0.			0.1230-006	0.1009-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	REF SIZE
GN	R-518	D287	L4094	025 C	ENV	FE	38

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	MEAN VALUE / LOW VALUE	MEAN / STD
0	1	0	0	31	5	0	0	0	1	IRQ09	AMP	0.1000-006 / 0.4615-007
0.	2.6	0.	0.	81.6	13.2	0.	0.	0.	2.6		0.1000-007	0.2306-007
1	0	0	0	3	34	0	0	0	0	IRR04	AMP	0.9000-007 / 0.4485-007
2.6	0.	0.	0.	7.9	89.5	0.	0.	0.	0.		0.1200-007	0.8985-008
0	0	13	0	5	14	0	4	2	0	IRR04	AMP	0.9100-007 / 0.4639-007
0.	0.	34.2	0.	13.2	36.8	0.	10.5	5.3	0.		0.4700-007	0.2220-008
0	3	0	9	4	0	18	2	0	0	IRS02	AMP	0.4000-007 / 0.4611-007
0.	7.9	0.	23.7	15.8	0.	47.4	5.3	0.	0.		0.4300-007	0.2890-008
0	1	2	0	18	7	0	8	2	0	GR02	AMP	0.9000-007 / 0.4766-007
0.	2.6	5.3	0.	47.4	18.4	0.	21.1	5.3	0.		0.4900-007	0.2422-008
0	1	0	13	0	9	14	1	0	0	IRQ09	AMP	0.4000-007 / 0.4600-007
0.	2.6	0.	34.2	0.	23.7	36.8	2.6	0.	0.		0.4300-007	0.2940-008
0	0	2	0	25	5	0	4	1	1	IRC01	AMP	0.9100-007 / 0.4747-007
0.	0.	5.3	0.	65.8	13.2	0.	10.5	2.6	2.6		0.4600-007	0.2053-008
0	0	0	18	5	0	11	4	0	0	IDB01	AMP	0.9000-007 / 0.4803-007
0.	0.	0.	47.4	13.2	0.	28.9	10.5	0.	0.		0.4700-007	0.2108-008
2	0	1	5	0	18	9	3	0	0	IDQ01	AMP	0.4900-007 / 0.4700-007
5.3	0.	2.6	13.2	0.	47.4	23.7	7.9	0.	0.		0.4800-007	0.2204-008
0	0	0	0	37	0	0	0	0	1	IDE01	AMP	0.3000-006 / 0.5947-007
0.	0.	0.	0.	97.4	0.	0.	0.	0.	2.6		0.4800-007	0.4526-007

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4054	R510N	7898	UGS	025 C	400	XH	11

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	3	1	0	2	5	0	0	0	IG182	AMP	0.5700-007 / 0.4300-007	0.5182-007 / 0.5212-008
0.	0.	27.3	9.1	0.	18.2	45.5	0.	0.	0.				
0	1	0	1	3	1	5	0	0	0	IG261	AMP	0.5400-007 / 0.3300-007	0.4845-007 / 0.6517-008
0.	9.1	0.	9.1	27.3	9.1	45.5	0.	0.	0.				
0	0	0	0	9	0	0	0	2	0	IG600	AMP	0.1438-004 / 0.8200-007	0.2693-005 / 0.5778-005
0.	0.	0.	0.	81.8	0.	0.	0.	18.2	0.				
0	0	0	2	5	3	0	0	1	0	BTAGI	AMP	0.5032-004 / 0.6382-005	0.1729-004 / 0.1219-004
0.	0.	0.	18.2	45.5	27.3	0.	0.	9.1	0.				
0	0	2	0	5	3	0	0	1	0	BTATI	AMP	0.5814-004 / 0.6110-005	0.2344-004 / 0.1378-004
0.	0.	18.2	0.	45.5	27.3	0.	0.	9.1	0.				
0	0	0	0	9	1	0	0	1	0	IDSL	AMP	0.7132-004 / 0.2490-005	0.1079-004 / 0.2044-004
0.	0.	0.	0.	81.8	9.1	0.	0.	9.1	0.				
0	0	0	3	4	2	0	1	1	0	IBSH	AMP	0.8857-004 / 0.1142-004	0.3303-004 / 0.2382-004
0.	0.	0.	27.3	36.4	18.2	0.	9.1	9.1	0.				
0	0	0	0	10	0	0	0	0	1	IL5	AMP	0.6340-006 / 0.8700-007	0.1476-006 / 0.1615-006
0.	0.	0.	0.	90.9	0.	0.	0.	0.	9.1				
0	0	3	2	0	1	4	1	0	0	IL-12	AMP	0.9600-007 / 0.7500-007	0.8673-007 / 0.8392-008
0.	0.	27.3	18.2	0.	9.1	36.4	9.1	0.	0.				
0	0	3	1	1	0	6	0	0	0	IL-11	AMP	0.1100-006 / 0.9200-007	0.1034-006 / 0.7852-008
0.	0.	27.3	9.1	9.1	0.	54.5	0.	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GS	M518N	1318	L4054	025 C	340	XH	37

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	1	0	2	4	12	10	6	1	1	0	IRQ09	AMP	0.4800-007	0.4192-007
	2.7	0.	5.4	10.8	32.4	27.0	16.2	2.7	2.7	0.			0.3500-007	0.2228-008
	0	1	4	4	12	5	6	5	0	0	IQR04	AMP	0.4800-007	0.4419-007
	0.	2.7	10.8	10.8	32.4	13.5	16.2	13.5	0.	0.			0.3900-007	0.2295-008
	0	2	3	0	8	14	6	4	0	0	IBR04	AMP	0.4800-007	0.4570-007
	0.	5.4	8.1	0.	21.6	37.8	16.2	10.8	0.	0.			0.4100-007	0.1614-008
	0	2	5	2	7	8	6	5	0	0	IRB02	AMP	0.4900-007	0.4419-007
	0.	5.4	13.5	5.4	18.9	21.6	21.6	13.5	0.	0.			0.3900-007	0.2493-008
	0	1	4	2	10	12	0	8	0	0	IQB02	AMP	0.4900-007	0.4558-007
	0.	2.7	10.8	5.4	27.0	32.4	0.	21.6	0.	0.			0.3900-007	0.2442-008
	0	1	8	2	6	7	10	3	0	0	IBQ09	AMP	0.4800-007	0.4403-007
	0.	2.7	21.6	5.4	16.2	18.9	27.0	8.1	0.	0.			0.3900-007	0.2409-008
	0	1	7	0	10	5	8	6	0	0	IRC01	AMP	0.4800-007	0.4527-007
	0.	2.7	18.9	0.	27.0	13.5	21.6	16.2	0.	0.			0.3900-007	0.2244-008
	0	2	3	2	9	9	4	8	0	0	ICB01	AMP	0.4900-007	0.4570-007
	0.	5.4	8.1	5.4	24.3	24.3	10.8	21.6	0.	0.			0.4100-007	0.1915-008
	0	0	6	4	7	11	6	3	0	0	ICQ01	AMP	0.4800-007	0.4554-007
	0.	0.	16.2	10.8	18.9	29.7	16.2	8.1	0.	0.			0.3900-007	0.2652-008
	0	0	0	0	36	0	0	0	0	1	ICE01	AMP	0.4970-006	0.7543-007
	0.	0.	0.	0.	97.3	0.	0.	0.	0.	2.7			0.3900-007	0.7466-007

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GS	R518N	2208	L4054	025 0	694	XH	34

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	8	0	8	11	4	1	2	0	IRQ09	AMP	0.5900-007 / 0.5200-007	0.5465-007 / 0.1612-008
0.	0.	23.5	0.	23.5	32.4	11.8	2.9	5.9	0.				
0	0	3	0	16	9	0	6	0	0	IGR04	AMP	0.5700-007 / 0.5400-007	0.5553-007 / 0.8956-009
0.	0.	8.8	0.	47.1	26.5	0.	17.6	0.	0.				
0	0	5	7	0	14	3	4	1	0	IBR04	AMP	0.6100-007 / 0.5500-007	0.5694-007 / 0.1369-008
0.	0.	14.7	20.6	0.	41.2	8.8	11.8	2.9	0.				
0	1	4	0	9	12	0	8	0	0	IRB02	AMP	0.5700-007 / 0.5300-007	0.5565-007 / 0.1070-008
0.	2.9	11.8	0.	26.5	35.3	0.	23.5	0.	0.				
0	0	4	4	0	18	0	6	2	0	IGB02	AMP	0.5900-007 / 0.5500-007	0.5694-007 / 0.1013-008
0.	0.	11.8	11.8	0.	52.9	0.	17.6	5.9	0.				
0	2	2	0	11	11	0	8	0	0	IBQ09	AMP	0.5700-007 / 0.5300-007	0.5562-007 / 0.1101-008
0.	5.9	5.9	0.	32.4	32.4	0.	23.5	0.	0.				
0	0	2	10	7	0	12	2	1	0	IRC01	AMP	0.5900-007 / 0.5400-007	0.5615-007 / 0.1184-008
0.	0.	5.9	29.4	20.6	0.	35.3	5.9	2.9	0.				
0	1	7	0	8	13	0	4	1	0	ICB01	AMP	0.5900-007 / 0.5300-007	0.5638-007 / 0.1256-008
0.	2.9	20.6	0.	23.5	38.2	0.	11.8	2.9	0.				
0	0	7	0	11	6	0	10	0	0	ICQ01	AMP	0.5700-007 / 0.5200-007	0.5512-007 / 0.1684-008
0.	0.	20.6	0.	32.4	17.6	0.	29.4	0.	0.				
0	0	8	0	8	7	8	3	0	0	ICE01	AMP	0.5800-007 / 0.5000-007	0.5615-007 / 0.2076-008
0.	0.	23.5	0.	23.5	20.6	23.5	8.8	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GS	R518N	3068	L4054	025 C	10C	XH	34

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0 / 0.	1 / 2.9	1 / 2.9	8 / 23.5	13 / 38.2	5 / 14.7	0 / 0.	3 / 8.8	3 / 8.8	0 / 0.	IRG09	AMPI	0.5100-007 / 0.4500-007	0.4821-007 / 0.1388-008
0 / 0.	2 / 5.9	5 / 14.7	0 / 0.	0 / 0.	23 / 67.6	0 / 0.	3 / 8.8	0 / 0.	1 / 2.9	IGR04	AMPI	0.5000-007 / 0.4500-007	0.4691-007 / 0.8658-009
0 / 0.	0 / 0.	10 / 29.4	0 / 0.	8 / 23.5	0 / 0.	13 / 38.2	3 / 8.8	0 / 0.	0 / 0.	IBR04	AMPI	0.5000-007 / 0.4700-007	0.4826-007 / 0.9942-009
0 / 0.	0 / 0.	1 / 2.9	15 / 44.1	0 / 0.	6 / 17.6	0 / 0.	12 / 35.3	0 / 0.	0 / 0.	IRB02	AMPI	0.5000-007 / 0.4600-007	0.4791-007 / 0.1055-008
0 / 0.	0 / 0.	5 / 14.7	0 / 0.	21 / 61.8	0 / 0.	4 / 11.8	3 / 8.8	1 / 2.9	0 / 0.	IGB02	AMPI	0.5200-007 / 0.4700-007	0.4915-007 / 0.1077-008
0 / 0.	2 / 5.9	1 / 2.9	0 / 0.	16 / 47.1	8 / 23.5	0 / 0.	5 / 14.7	2 / 5.9	0 / 0.	IBG09	AMPI	0.5200-007 / 0.4700-007	0.4956-007 / 0.1160-008
1 / 2.9	1 / 2.9	3 / 8.8	0 / 0.	12 / 3.3	13 / 38.2	0 / 0.	4 / 11.8	0 / 0.	0 / 0.	IRC01	AMPI	0.5300-007 / 0.4800-007	0.5158-007 / 0.1101-008
0 / 0.	0 / 0.	1 / 2.9	16 / 47.1	0 / 0.	6 / 17.6	0 / 0.	11 / 32.4	0 / 0.	0 / 0.	ICB01	AMPI	0.5300-007 / 0.5000-007	0.5179-007 / 0.9464-009
0 / 0.	2 / 5.9	3 / 8.8	0 / 0.	2 / 5.9	18 / 52.9	8 / 23.5	1 / 2.9	0 / 0.	0 / 0.	ICG01	AMPI	0.5300-007 / 0.4700-007	0.5082-007 / 0.1314-008
0 / 0.	1 / 2.9	6 / 17.6	1 / 2.9	12 / 35.3	2 / 5.9	0 / 0.	12 / 35.3	0 / 0.	0 / 0.	ICE01	AMPI	0.5200-007 / 0.4600-007	0.4932-007 / 0.1609-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4054	R5180	7098	GS	025 C	40C	XH	34

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
1	0	1	7	7	7	10	1	0	0	IRG09	AMP	0.5300-007 / 0.4485-007
2.9	0.	2.9	20.6	20.6	20.6	29.4	2.9	0.	0.			0.2300-007 / 0.5456-008
0	0	8	3	9	1	3	10	0	0	IGR04	AMP	0.5400-007 / 0.4747-007
0.	0.	23.5	8.8	26.5	2.9	8.8	29.4	0.	0.			0.4000-007 / 0.4343-008
0	0	7	3	10	1	6	7	0	0	IBR04	AMP	0.5600-007 / 0.4871-007
0.	0.	20.6	8.8	29.4	2.9	17.6	20.6	0.	0.			0.4200-007 / 0.4629-008
0	0	8	1	8	7	1	9	0	0	IRB02	AMP	0.5600-007 / 0.4982-007
0.	0.	23.5	2.9	23.5	20.6	2.9	26.5	0.	0.			0.4200-007 / 0.4783-008
0	0	8	2	10	0	2	12	0	0	IGB02	AMP	0.5700-007 / 0.5082-007
0.	0.	23.5	5.9	29.4	0.	5.9	35.3	0.	0.			0.4300-007 / 0.4706-008
0	1	5	4	9	5	0	10	0	0	IBG09	AMP	0.5400-007 / 0.4665-007
0.	2.9	14.7	11.8	26.5	14.7	0.	29.4	0.	0.			0.3200-007 / 0.5175-008
0	1	4	5	10	4	3	7	0	0	IRC01	AMP	0.6000-007 / 0.5168-007
0.	2.9	11.8	14.7	29.4	11.8	8.8	20.6	0.	0.			0.4100-007 / 0.5174-008
0	0	7	3	10	3	3	8	0	0	ICB01	AMP	0.6000-007 / 0.5171-007
0.	0.	20.6	8.8	29.4	8.8	8.8	23.5	0.	0.			0.4300-007 / 0.5072-008
0	0	5	5	10	1	8	5	0	0	ICG01	AMP	0.6000-007 / 0.5053-007
0.	0.	14.7	14.7	29.4	2.9	23.5	14.7	0.	0.			0.3900-007 / 0.5848-008
0	0	4	9	7	0	5	9	0	0	ICE01	AMP	0.6000-007 / 0.4871-007
0.	0.	11.8	26.5	20.6	0.	14.7	26.5	0.	0.			0.4000-007 / 0.6206-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
QS	R-518	D287	L4054	025 C	ENV	FE	38

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	9	0	15	0	0	14	0	0	IECOT	AMP	0.3300-007 / 0.3100-007	0.3813-007 / 0.9771-009
0.	0.	23.7	0.	39.5	0.	0.	35.8	0.	0.				
0	0	2	11	9	8	2	4	2	0	IEBOT	AMP	0.1590-006 / 0.4300-007	0.7766-007 / 0.8949-007
0.	0.	5.3	28.9	23.7	21.1	5.3	10.5	5.3	0.				
0	0	3	5	14	10	2	3	0	1	BTATLI	AMP	0.1357-003 / 0.1149-004	0.3625-004 / 0.8333-004
0.	0.	7.9	13.2	36.8	26.3	5.3	7.9	0.	2.6				
0	0	7	3	16	0	4	7	1	0	BTATWI	AMP	0.3156-002 / 0.5102-003	0.1559-002 / 0.6776-003
0.	0.	18.4	7.9	42.1	0.	10.5	18.4	2.6	0.				
1	0	3	0	16	13	0	5	0	0	ICBOO	AMP	0.5500-007 / 0.3900-007	0.4947-007 / 0.8275-008
2.6	0.	7.9	0.	42.1	34.2	0.	13.2	0.	0.				
0	2	1	0	12	18	0	5	0	0	ICEOO	AMP	0.5100-007 / 0.4300-007	0.4795-007 / 0.1659-008
0.	5.3	2.6	0.	31.6	47.4	0.	13.2	0.	0.				
0	0	0	15	0	13	5	5	0	0	IECOB	AMP	0.3600-007 / 0.3300-007	0.3400-007 / 0.1040-008
0.	0.	0.	39.5	0.	34.2	13.2	13.2	0.	0.				
0	0	0	6	20	6	1	3	1	1	IEBOB	AMP	0.3330-006 / 0.4500-007	0.9252-007 / 0.6209-007
0.	0.	0.	15.8	52.6	15.8	2.6	7.9	2.6	2.6				
0	0	7	4	12	6	3	4	2	0	BTACLI	AMP	0.1065-003 / 0.1028-004	0.3879-004 / 0.8483-004
0.	0.	18.4	10.5	31.6	15.8	7.9	10.5	5.3	0.				
0	0	7	3	15	1	3	8	1	0	BTACWI	AMP	0.2839-002 / 0.4927-003	0.1373-002 / 0.9082-003
0.	0.	18.4	7.9	39.5	2.6	7.9	21.1	2.6	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GS	R915N	1318	L4054	025 C	340	H	37

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	2	0	10	3	10	10	1	1	0	IECOT	AMP	0.3400-007 / 0.2700-007	0.3027-007 / 0.1991-008
0.	5.4	0.	27.0	8.1	27.0	27.0	2.7	2.7	0.			
0	0	3	10	8	7	2	5	2	0	IEBOT	AMP	0.1300-006 / 0.4200-007	0.7886-007 / 0.8545-007
0.	0.	8.1	27.0	21.6	18.9	5.4	13.5	5.4	0.			
0	0	1	7	14	9	2	3	0	1	BTATL	AMP	0.1549-003 / 0.1294-004	0.4050-004 / 0.2688-004
0.	0.	2.7	18.9	37.8	24.3	5.4	8.1	0.	2.7			
0	0	7	3	16	0	3	7	1	0	BTATW	AMP	0.3128-002 / 0.5856-003	0.1326-002 / 0.6875-003
0.	0.	18.9	8.1	43.2	0.	8.1	18.9	2.7	0.			
1	1	3	4	5	14	6	3	0	0	ICBOO	AMP	0.5100-007 / 0.3500-007	0.4338-007 / 0.8085-008
2.7	2.7	8.1	10.8	13.5	37.8	16.2	8.1	0.	0.			
0	0	9	0	6	13	4	5	0	0	ICEOO	AMP	0.4900-007 / 0.3900-007	0.4427-007 / 0.2950-008
0.	0.	24.3	0.	16.2	35.1	10.8	13.5	0.	0.			
0	0	7	1	12	5	5	7	0	0	ICCOO	AMP	0.3600-007 / 0.2900-007	0.3159-007 / 0.1785-008
0.	0.	18.9	2.7	32.4	13.5	13.5	18.9	0.	0.			
0	0	0	7	18	7	0	3	1	1	IEBOO	AMP	0.2840-006 / 0.3900-007	0.9670-007 / 0.5746-007
0.	0.	0.	18.9	48.6	18.9	0.	8.1	2.7	2.7			
0	0	7	2	13	6	2	6	1	0	BTACL	AMP	0.1127-003 / 0.1104-004	0.4105-004 / 0.2596-004
0.	0.	18.9	5.4	35.1	16.2	5.4	16.2	2.7	0.			
0	0	7	3	15	1	2	8	1	0	BTACW	AMP	0.2795-002 / 0.4811-003	0.1313-002 / 0.6701-003
0.	0.	18.9	8.1	40.5	2.7	5.4	21.6	2.7	0.			

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
65	8518N	2208	L4054	025 0	694	XH	34

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	6	0	0	23	0	4	0	1	IECOT	AMP	0.4200-007 / 0.3900-007	0.4000-007 / 0.6513-009
0.	0.	17.6	0.	0.	67.6	0.	11.8	0.	2.9				
0	0	2	9	8	7	3	3	2	0	IEBOT	AMP	0.1490-006 / 0.5100-007	0.8071-007 / 0.8488-007
0.	0.	5.9	26.5	23.5	20.6	8.8	8.8	5.9	0.				
0	0	0	8	13	7	2	3	0	1	BTATL	AMP	0.1413-003 / 0.1182-004	0.3630-004 / 0.2540-004
0.	0.	0.	23.5	38.2	20.6	5.9	8.8	0.	2.9				
0	0	7	1	16	1	3	5	1	0	BTATH	AMP	0.3126-002 / 0.5045-003	0.1299-002 / 0.6746-003
0.	0.	20.6	2.9	47.1	2.9	8.8	14.7	2.9	0.				
1	0	2	0	5	20	0	5	1	0	IEBOG	AMP	0.6100-007 / 0.4900-007	0.5700-007 / 0.6975-008
2.9	0.	5.9	0.	14.7	58.8	0.	14.7	2.9	0.				
1	1	2	0	4	20	5	1	0	0	IEEOG	AMP	0.5900-007 / 0.4300-007	0.5482-007 / 0.3520-008
2.9	2.9	5.9	0.	11.8	58.8	14.7	2.9	0.	0.				
0	0	4	0	15	0	13	0	2	0	IECOB	AMP	0.4300-007 / 0.4000-007	0.4138-007 / 0.9791-009
0.	0.	11.8	0.	44.1	0.	38.2	0.	5.9	0.				
0	0	0	5	18	7	0	2	0	2	IEBOB	AMP	0.2910-006 / 0.5100-007	0.9459-007 / 0.5713-007
0.	0.	0.	14.7	52.9	20.6	0.	5.9	0.	5.9				
0	0	4	5	12	5	2	5	1	0	BTACL	AMP	0.1028-003 / 0.9780-005	0.3553-004 / 0.2284-004
0.	0.	11.8	14.7	35.3	14.7	5.9	14.7	2.9	0.				
0	0	7	1	16	1	1	7	1	0	BTACH	AMP	0.2758-002 / 0.4752-003	0.1273-002 / 0.6727-003
0.	0.	20.6	2.9	47.1	2.9	2.9	20.6	2.9	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
05	8518N	3068	L4054	025 C	100	XH	34

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	3	4	0	9	0	17	1	0	0	IECOT	AMP	0.4100E-007 / 0.3700E-007	0.3926E-007 / 0.2094E-008
0.0	8.8	11.8	0.0	26.5	0.0	50.0	2.9	0.0	0.0				
0	0	2	8	9	7	3	3	2	0	IEBOT	AMP	0.1470E-006 / 0.5100E-007	0.7815E-007 / 0.4467E-007
0.0	0.0	5.9	23.5	26.5	20.6	8.8	8.8	5.9	0.0				
0	0	1	7	13	7	2	3	0	1	BTATLI	AMP	0.1965E-003 / 0.1732E-004	0.5286E-004 / 0.3528E-004
0.0	0.0	2.9	20.6	38.2	20.6	5.9	8.8	0.0	2.9				
0	0	7	1	16	1	3	5	1	0	BTATWI	AMP	0.3150E-002 / 0.5066E-003	0.1800E-002 / 0.6776E-003
0.0	0.0	20.6	2.9	47.1	2.9	8.8	14.7	2.9	0.0				
1	0	1	0	14	10	3	5	0	0	IDBOC	AMP	0.5400E-007 / 0.4200E-007	0.5044E-007 / 0.5191E-008
2.9	0.0	2.9	0.0	41.2	29.4	8.8	14.7	0.0	0.0				
1	1	2	0	5	21	4	0	0	0	IDECO	AMP	0.5100E-007 / 0.3400E-007	0.4803E-007 / 0.5442E-008
2.9	2.9	5.9	0.0	14.7	61.8	11.8	0.0	0.0	0.0				
0	1	0	0	26	0	0	7	0	0	IECOB	AMP	0.4100E-007 / 0.3900E-007	0.4010E-007 / 0.4586E-009
0.0	2.9	0.0	0.0	76.5	0.0	0.0	20.6	0.0	0.0				
0	0	0	5	18	7	0	2	0	2	IEBOB	AMP	0.2800E-006 / 0.5100E-007	0.9815E-007 / 0.5651E-007
0.0	0.0	0.0	14.7	52.9	20.6	0.0	5.9	0.0	5.9				
0	0	6	3	12	4	3	5	1	0	BTADLI	AMP	0.1455E-003 / 0.1533E-004	0.5178E-004 / 0.3204E-004
0.0	0.0	17.6	8.8	35.3	11.8	8.8	14.7	2.9	0.0				
0	0	7	1	16	1	1	7	1	0	BTADWI	AMP	0.2700E-002 / 0.4027E-003	0.1279E-002 / 0.6743E-003
0.0	0.0	20.6	2.9	47.1	2.9	2.9	20.6	2.9	0.0				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4054	R5188	7898	GS	025 G	400	XH	34

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	6	5	9	2	1	11	0	0	IEBOT	AMP	0.4000-007 / 0.3300-007	0.3659-007 / 0.2017-008
0.	0.	17.6	14.7	26.5	5.9	2.9	32.4	0.	0.				
0	0	3	7	10	6	2	4	2	0	IEBOT	AMP	0.1400-006 / 0.5200-007	0.7938-007 / 0.2489-007
0.	0.	8.8	20.6	29.4	17.6	5.9	11.8	5.9	0.				
0	0	1	7	12	9	1	3	0	1	BTATL	AMP	0.1519-003 / 0.1227-004	0.3899-004 / 0.2630-004
0.	0.	2.9	20.6	35.3	26.5	2.9	8.8	0.	2.9				
0	0	7	2	12	4	3	5	1	0	BTATH	AMP	0.3105-002 / 0.4780-003	0.1274-002 / 0.6486-003
0.	0.	20.6	5.9	35.3	11.8	8.8	14.7	2.9	0.				
0	1	7	4	3	7	9	3	0	0	ICBOG	AMP	0.6000-007 / 0.3800-007	0.5112-007 / 0.5974-008
0.	2.9	20.6	11.8	8.8	20.6	26.5	8.8	0.	0.				
0	0	8	2	9	1	4	10	0	0	ICEOG	AMP	0.5600-007 / 0.4100-007	0.4912-007 / 0.5575-008
0.	0.	23.5	5.9	26.5	2.9	11.8	29.4	0.	0.				
0	0	3	10	4	0	12	5	0	0	IECOB	AMP	0.4200-007 / 0.3500-007	0.3871-007 / 0.1883-008
0.	0.	8.8	29.4	11.8	0.	35.3	14.7	0.	0.				
0	0	0	7	16	6	1	2	0	2	IEBOB	AMP	0.2700-006 / 0.5400-007	0.9441-007 / 0.5418-007
0.	0.	0.	20.6	47.1	17.6	2.9	5.9	0.	5.9				
0	0	7	4	10	5	4	2	2	0	BTACL	AMP	0.9500-004 / 0.1011-004	0.3625-004 / 0.2154-004
0.	0.	20.6	11.8	29.4	14.7	11.8	5.9	5.9	0.				
0	0	7	3	13	2	1	7	1	0	BTACH	AMP	0.2506-002 / 0.4470-003	0.1221-002 / 0.6339-003
0.	0.	20.6	8.8	38.2	5.9	2.9	20.6	2.9	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GS	R-518	D287	L4054	025 C	ENV	FE	38

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
1	0	4	0	15	5	10	2	1	0	IC1C2	AMP	0.5100-007 / 0.4300-007	0.4766-007 / 0.1547-008
2.6	0.	10.5	0.	39.5	13.2	26.3	5.3	2.6	0.				
0	0	9	0	8	17	0	3	1	0	IC2C1	AMP	0.4900-007 / 0.4500-007	0.4645-007 / 0.1032-008
0.	0.	23.7	0.	21.1	44.7	0.	7.9	2.6	0.				
0	0	0	0	31	0	0	0	7	0	IC6GO	AMP	0.1431-004 / 0.1020-006	0.2724-005 / 0.5977-005
0.	0.	0.	0.	81.6	0.	0.	0.	18.4	0.				
0	0	3	9	14	1	1	9	1	0	BTACK	AMP	0.5027-004 / 0.5840-005	0.2071-004 / 0.1314-004
0.	0.	7.9	23.7	36.8	2.6	2.6	23.7	2.6	0.				
0	0	7	7	10	3	2	8	1	0	BTATI	AMP	0.5765-004 / 0.1078-004	0.2558-004 / 0.1273-004
0.	0.	18.4	18.4	26.3	7.9	5.3	21.1	2.6	0.				
0	0	0	0	28	9	0	0	0	1	IDSL	AMP	0.7839-004 / 0.6000-007	0.7480-005 / 0.1261-004
0.	0.	0.	0.	73.7	23.7	0.	0.	0.	2.6				
0	0	8	0	12	9	3	5	0	1	IDSH	AMP	0.9978-004 / 0.4590-005	0.3428-004 / 0.1879-004
0.	0.	21.1	0.	31.6	23.7	7.9	13.2	0.	2.6				
0	0	5	5	10	6	8	2	2	0	ILB	AMP	0.1190-006 / 0.1130-006	0.1159-006 / 0.1655-008
0.	0.	13.2	13.2	26.3	15.8	21.1	5.3	5.3	0.				
1	0	0	0	1	36	0	0	0	0	IL-12	AMP	0.1070-006 / 0.4000-008	0.1006-006 / 0.1624-007
2.6	0.	0.	0.	2.6	94.7	0.	0.	0.	0.				
0	0	9	0	12	6	4	7	0	0	IL-11	AMP	0.1230-006 / 0.1170-006	0.1202-006 / 0.1902-008
0.	0.	23.7	0.	31.6	15.8	10.5	18.4	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GS	R518N	1318	L4054	025 0	340	XH	37

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	5	6	9	6	7	3	0	1			
0.	0.	13.5	16.2	24.3	16.2	18.9	8.1	0.	2.7			
									IC1CB	AMP	0.5100-007	0.4511-007
											0.3900-007	0.2622-008
1	0	5	1	9	10	5	6	0	0			
2.7	0.	13.5	2.7	24.3	27.0	13.5	16.2	0.	0.			
									IC2CL	AMP	0.4600-007	0.4849-007
											0.3400-007	0.2755-008
0	0	0	0	30	0	0	0	7	0			
0.	0.	0.	0.	81.1	0.	0.	0.	18.9	0.			
									IC6GQ	AMP	0.1429-004	0.2771-005
											0.8900-007	0.9651-005
0	0	3	8	15	1	1	8	1	0			
0.	0.	8.1	21.6	40.5	2.7	2.7	21.6	2.7	0.			
									BTACE	AMP	0.5006-004	0.2048-004
											0.5895-005	0.1517-004
0	0	3	11	7	6	2	7	1	0			
0.	0.	8.1	29.7	18.9	16.2	5.4	18.9	2.7	0.			
									BTATE	AMP	0.5813-004	0.2953-004
											0.1088-004	0.1271-004
0	0	0	0	28	8	0	0	0	1			
0.	0.	0.	0.	75.7	21.6	0.	0.	0.	2.7			
									IDSLI	AMP	0.7559-004	0.6929-005
											0.1600-006	0.1228-004
0	0	7	1	12	8	3	5	0	1			
0.	0.	18.9	2.7	32.4	21.6	8.1	13.5	0.	2.7			
									IDSWI	AMP	0.9255-004	0.3249-004
											0.6940-005	0.1769-004
0	0	8	2	10	7	3	7	0	0			
0.	0.	21.6	5.4	27.0	18.9	8.1	18.9	0.	0.			
									IL5	AMP	0.1210-006	0.1151-004
											0.1100-006	0.8144-008
0	1	3	9	6	5	6	7	0	0			
0.	2.7	8.1	24.3	16.2	13.5	16.2	18.9	0.	0.			
									IL-12	AMP	0.1090-006	0.1035-004
											0.9600-007	0.8940-008
0	0	8	4	7	10	3	4	1	0			
0.	0.	21.6	10.8	18.9	27.0	8.1	10.8	2.7	0.			
									IL-11	AMP	0.1260-006	0.1193-004
											0.1150-006	0.8903-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GS	R518N	2208	L4054	025 C	694	XH	34

	*3STD	*2STD	*1STD	*.67STD	MEAN	*.67STD	*1STD	*2STD	*3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	2	4	0	6	8	9	5	0	0	IC1C2	AMP	0.5800-007	0.5885-007
	0.	5.9	11.8	0.	17.6	23.5	26.5	14.7	0.	0.			0.5200-007	0.1672-008
	1	0	0	0	7	24	2	0	0	0	IC2C1	AMP	0.5700-007	0.5447-007
	2.9	0.	0.	0.	20.6	70.6	5.9	0.	0.	0.			0.4100-007	0.6585-008
	0	0	0	0	27	0	0	7	0	0	IC6GD	AMP	0.1422-004	0.3030-005
	0.	0.	0.	0.	79.4	0.	0.	20.6	0.	0.			0.1100-006	0.9783-005
	0	0	2	7	14	3	0	6	2	0	BTACI	AMP	0.5000-004	0.1980-004
	0.	0.	5.9	20.6	41.2	8.8	0.	17.6	5.9	0.			0.5887-005	0.1308-004
	0	0	2	10	8	6	1	5	2	0	BTATI	AMP	0.5799-004	0.2485-004
	0.	0.	5.9	29.4	23.5	17.6	2.9	14.7	5.9	0.			0.1089-004	0.1284-004
	0	0	0	0	26	7	0	0	0	1	IDSL	AMP	0.7807-004	0.7363-005
	0.	0.	0.	0.	76.5	20.6	0.	0.	0.	2.9			0.2700-006	0.1325-004
	0	0	7	0	12	6	4	4	0	1	IDSH	AMP	0.9447-004	0.3260-004
	0.	0.	20.6	0.	35.3	17.6	11.8	11.8	0.	2.9			0.7430-005	0.1842-004
	0	2	2	0	14	8	0	8	0	0	IL5	AMP	0.1380-006	0.1356-006
	0.	5.9	5.9	0.	41.2	23.5	0.	23.5	0.	0.			0.1330-006	0.1209-008
	0	0	13	0	8	0	0	12	1	0	IL-12	AMP	0.1240-006	0.1220-006
	0.	0.	38.2	0.	23.5	0.	0.	35.3	2.9	0.			0.1210-006	0.0370-009
	0	1	2	0	12	11	0	7	1	0	IL-11	AMP	0.1430-006	0.1407-006
	0.	2.9	5.9	0.	35.3	32.4	0.	20.6	2.9	0.			0.1380-006	0.1060-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
GS	R518N	3068	L4054	025 C	10C	XH	34

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	4	8	3	9	4	5	1	0	IC1C2	AMP	0.5500-007	0.5056-007
0.	0.	11.8	23.5	8.8	26.5	11.8	14.7	2.9	0.			0.4700-007	0.1988-008
1	0	0	0	16	8	8	1	0	0	IC2C1	AMP	0.5000-007	0.4747-007
2.9	0.	0.	0.	47.1	23.5	23.5	2.9	0.	0.			0.3600-007	0.2219-008
0	0	0	0	27	0	0	7	0	0	IC6G0	AMP	0.1423-004	0.3020-005
0.	0.	0.	0.	79.4	0.	0.	20.6	0.	0.			0.9900-007	0.8794-005
0	0	2	7	14	3	0	6	2	0	BTAC1	AMP	0.5005-004	0.1985-004
0.	0.	5.9	20.6	41.2	8.8	0.	17.6	5.9	0.			0.5911-005	0.1310-004
0	0	2	10	8	6	1	5	2	0	BTAT1	AMP	0.5799-004	0.2491-004
0.	0.	5.9	29.4	23.5	17.6	2.9	14.7	5.9	0.			0.1093-004	0.1255-004
0	0	0	0	26	7	0	0	0	1	IDSL	AMP	0.7929-004	0.7580-005
0.	0.	0.	0.	76.5	20.6	0.	0.	0.	2.9			0.1700-006	0.1343-004
0	0	7	0	12	6	4	4	0	1	IDSH	AMP	0.9540-004	0.3290-004
0.	0.	20.6	0.	35.3	17.6	11.8	11.8	0.	2.9			0.7610-005	0.1865-004
0	1	0	8	13	2	0	9	0	1	IL5	AMP	0.1260-006	0.1214-006
0.	2.9	0.	23.5	38.2	5.9	0.	26.5	0.	2.9			0.1180-006	0.1500-008
0	0	8	1	8	11	0	6	0	0	IL-12	AMP	0.1070-006	0.1052-006
0.	0.	23.5	2.9	23.5	32.4	0.	17.6	0.	0.			0.1030-006	0.1424-008
0	0	6	0	8	9	10	1	0	0	IL-11	AMP	0.1280-006	0.1256-006
0.	0.	17.6	0.	23.5	26.5	29.4	2.9	0.	0.			0.1230-006	0.1415-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4054	R5180	7098	GS	025 G	406	XH	34

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	0	8	4	3	6	4	9	0	0	IC1D2	AMP	0.5700-007 / 0.4000-007	0.5021-007 / 0.5330-008
	0.	0.	23.5	11.8	8.8	17.6	11.8	26.5	0.	0.				
	0	0	7	2	11	1	3	10	0	0	IC2G1	AMP	0.5400-007 / 0.4000-007	0.4806-007 / 0.4362-008
	0.	0.	20.6	5.9	32.4	2.9	8.8	29.4	0.	0.				
	0	0	0	0	27	0	0	7	0	0	IC6GO	AMP	0.1438-004 / 0.7500-007	0.3031-005 / 0.5866-005
	0.	0.	0.	0.	79.4	0.	0.	20.6	0.	0.				
	0	0	3	7	12	4	0	6	2	0	BTAGI	AMP	0.4829-004 / 0.5499-005	0.1876-004 / 0.1257-004
	0.	0.	8.8	20.6	35.3	11.8	0.	17.6	5.9	0.				
	0	0	6	6	7	7	1	6	1	0	BTATI	AMP	0.5349-004 / 0.1014-004	0.2418-004 / 0.1182-004
	0.	0.	17.6	17.6	20.6	20.6	2.9	17.6	2.9	0.				
	0	0	0	0	26	7	0	0	0	1	IDSL	AMP	0.7713-004 / 0.1300-006	0.7361-005 / 0.1302-004
	0.	0.	0.	0.	76.5	20.6	0.	0.	0.	2.9				
	0	0	7	1	10	7	3	5	0	1	IDSH	AMP	0.9412-004 / 0.6440-005	0.3239-004 / 0.1872-004
	0.	0.	20.6	2.9	29.4	20.6	8.8	14.7	0.	2.9				
	0	0	8	2	11	1	5	7	0	0	IL5	AMP	0.1070-006 / 0.7700-007	0.9409-007 / 0.9147-008
	0.	0.	23.5	5.9	32.4	2.9	14.7	20.6	0.	0.				
	0	0	7	4	8	2	6	7	0	0	IL-12	AMP	0.9700-007 / 0.7000-007	0.8385-007 / 0.9195-008
	0.	0.	20.6	11.8	23.5	5.9	17.6	20.6	0.	0.				
	0	0	7	4	9	1	6	7	0	0	IL-11	AMP	0.1100-006 / 0.8700-007	0.1004-006 / 0.8529-008
	0.	0.	20.6	11.8	26.5	2.9	17.6	20.6	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R-518	D287	UGO	025 0	000	FE	21

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
1	1	0	0	4	12	2	1	0	0	IRG09	AMP	0.4800-007 / 0.3200-007	0.4395-007 / 0.5926-008
4.8	4.8	0.	0.	19.0	57.1	9.5	4.8	0.	0.				
1	0	1	0	1	17	1	0	0	0	IGR04	AMP	0.4900-007 / 0.3700-007	0.4645-007 / 0.8562-008
4.8	0.	4.8	0.	4.8	81.0	4.8	0.	0.	0.				
0	0	7	0	4	4	0	6	0	0	IBR04	AMP	0.5100-007 / 0.4700-007	0.4845-007 / 0.2327-008
0.	0.	33.3	0.	19.0	19.0	0.	28.6	0.	0.				
1	0	1	1	5	8	4	1	0	0	IRB02	AMP	0.4800-007 / 0.3300-007	0.4433-007 / 0.5367-008
4.8	0.	4.8	4.8	23.8	38.1	19.0	4.8	0.	0.				
0	1	1	0	14	0	3	0	2	0	IGB02	AMP	0.4900-007 / 0.4500-007	0.4719-007 / 0.8729-009
0.	4.8	4.8	0.	66.7	0.	14.3	0.	9.5	0.				
0	2	0	5	2	11	0	1	0	0	IBG09	AMP	0.4800-007 / 0.4200-007	0.4605-007 / 0.1499-008
0.	9.5	0.	23.8	9.5	52.4	0.	4.8	0.	0.				
1	0	1	4	4	8	0	3	0	0	IRC01	AMP	0.4800-007 / 0.4100-007	0.4614-007 / 0.1821-008
4.8	0.	4.8	19.0	19.0	38.1	0.	14.3	0.	0.				
0	0	5	0	0	10	4	2	0	0	ICB01	AMP	0.4900-007 / 0.4500-007	0.4690-007 / 0.1261-008
0.	0.	23.8	0.	0.	47.6	19.0	9.5	0.	0.				
0	0	5	2	1	9	0	4	0	0	ICG01	AMP	0.4900-007 / 0.4300-007	0.4576-007 / 0.1998-008
0.	0.	23.8	9.5	4.8	42.9	0.	19.0	0.	0.				
0	2	1	0	8	3	7	0	0	0	ICE01	AMP	0.4700-007 / 0.4100-007	0.4524-007 / 0.1895-008
0.	9.5	4.8	0.	38.1	14.3	33.3	0.	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	1318	UGO	025 Q	340	XG	20

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	4	0	6	6	1	2	1	0	IRQ09	AMP	0.4800-007 / 0.3900-007	0.4190-007 / 0.8315-008
0.	0.	20.0	0.	30.0	30.0	5.0	10.0	5.0	0.				
0	0	2	4	5	3	3	3	0	0	IGR04	AMP	0.4900-007 / 0.3900-007	0.4375-007 / 0.8900-008
0.	0.	10.0	20.0	25.0	15.0	15.0	15.0	0.	0.				
0	1	3	0	5	6	2	3	0	0	IBR04	AMP	0.5000-007 / 0.3900-007	0.4575-007 / 0.2582-008
0.	5.0	15.0	0.	25.0	30.0	10.0	15.0	0.	0.				
0	1	5	0	3	5	4	2	0	0	IRB02	AMP	0.4700-007 / 0.3600-007	0.4005-007 / 0.8564-008
0.	5.0	25.0	0.	15.0	25.0	20.0	10.0	0.	0.				
0	1	3	0	3	7	3	3	0	0	IGB02	AMP	0.4900-007 / 0.3900-007	0.4490-007 / 0.8900-008
0.	5.0	15.0	0.	15.0	35.0	15.0	15.0	0.	0.				
0	0	2	6	2	3	3	4	0	0	IBQ09	AMP	0.4900-007 / 0.3900-007	0.4380-007 / 0.8254-008
0.	0.	10.0	30.0	10.0	15.0	15.0	20.0	0.	0.				
0	1	2	2	4	5	2	4	0	0	IRC01	AMP	0.4800-007 / 0.3500-007	0.4265-007 / 0.8150-008
0.	5.0	10.0	10.0	20.0	25.0	10.0	20.0	0.	0.				
0	0	3	2	6	4	1	4	0	0	IGB01	AMP	0.4900-007 / 0.3900-007	0.4450-007 / 0.8911-008
0.	0.	15.0	10.0	30.0	20.0	5.0	20.0	0.	0.				
0	0	3	0	8	4	1	3	1	0	IDQ01	AMP	0.4800-007 / 0.900-007	0.4230-007 / 0.8408-008
0.	0.	15.0	0.	40.0	20.0	5.0	15.0	5.0	0.				
0	0	3	2	4	7	0	4	0	0	IDE01	AMP	0.4700-007 / 0.3500-007	0.4165-007 / 0.8901-008
0.	0.	15.0	10.0	20.0	35.0	0.	20.0	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	RB180	2208	UGO	025 C	694	XG	18

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	1	2	0	1	12	1	0	1	0	IRQ09	AMP	0.6500-007 / 0.4200-007	0.5439-007 / 0.9237-008
0.	5.6	11.1	0.	5.6	66.7	5.6	0.	5.6	0.			
1	0	1	0	0	13	3	0	0	0	IQR04	AMP	0.5800-007 / 0.4600-007	0.5869-007 / 0.2720-008
5.6	0.	5.6	0.	0.	72.2	16.7	0.	0.	0.			
0	0	0	0	17	0	0	0	0	1	IBR04	AMP	0.2300-006 / 0.5600-007	0.6722-007 / 0.4064-007
0.	0.	0.	0.	94.4	0.	0.	0.	0.	5.6			
0	0	0	0	17	0	0	0	0	1	IRB02	AMP	0.2900-006 / 0.4600-007	0.6756-007 / 0.5557-007
0.	0.	0.	0.	94.4	0.	0.	0.	0.	5.6			
0	1	3	0	3	7	2	1	1	0	IQB02	AMP	0.6000-007 / 0.5300-007	0.5667-007 / 0.1609-008
0.	5.6	16.7	0.	16.7	38.9	11.1	5.6	5.6	0.			
0	1	2	0	2	12	1	0	0	0	IBQ09	AMP	0.5800-007 / 0.4200-007	0.5444-007 / 0.4369-008
0.	5.6	11.1	0.	11.1	66.7	5.6	0.	0.	0.			
1	0	1	0	7	4	4	1	0	0	IRC01	AMP	0.5800-007 / 0.4800-007	0.5828-007 / 0.8191-008
5.6	0.	5.6	0.	38.9	22.2	22.2	5.6	0.	0.			
0	1	1	3	5	5	0	3	0	0	ICB01	AMP	0.5800-007 / 0.5300-007	0.5617-007 / 0.1383-008
0.	5.6	5.6	16.7	27.8	27.8	0.	16.7	0.	0.			
0	0	3	4	2	2	3	4	0	0	ICQ01	AMP	0.5700-007 / 0.5100-007	0.5444-007 / 0.2064-008
0.	0.	16.7	22.2	11.1	11.1	16.7	22.2	0.	0.			
0	0	3	0	4	3	4	4	0	0	ICE01	AMP	0.5700-007 / 0.4700-007	0.5283-007 / 0.3148-008
0.	0.	16.7	0.	22.2	16.7	22.2	22.2	0.	0.			

FAMILY	TYPE	DATE	TEST NO.	TEMP.	TIME	TEST	SET SIZE
L4083	R5180	3078	UGO	025 C	10C	XG	17

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0 / 0.	1 / 5.9	1 / 5.9	2 / 11.8	3 / 17.6	7 / 41.2	1 / 5.9	2 / 11.8	0 / 0.	0 / 0.	IRG09	AMP	0.5200-007 / 0.4300-007	0.4841-007 / 0.8002-008
0 / 0.	1 / 5.9	2 / 11.8	0 / 0.	10 / 58.8	0 / 0.	0 / 0.	3 / 17.6	1 / 5.9	0 / 0.	IGR04	AMP	0.4900-007 / 0.4500-007	0.4706-007 / 0.8993-009
0 / 0.	0 / 0.	0 / 0.	0 / 0.	16 / 94.1	0 / 0.	0 / 0.	0 / 0.	0 / 0.	1 / 5.9	IBR04	AMP	0.8620-006 / 0.4600-007	0.9671-007 / 0.1972-006
0 / 0.	0 / 0.	0 / 0.	0 / 0.	16 / 94.1	0 / 0.	0 / 0.	0 / 0.	0 / 0.	1 / 5.9	IRB01	AMP	0.8300-006 / 0.4200-007	0.9288-007 / 0.1900-006
0 / 0.	0 / 0.	2 / 11.8	4 / 23.5	2 / 11.8	7 / 41.2	0 / 0.	2 / 11.8	0 / 0.	0 / 0.	IGB01	AMP	0.5000-007 / 0.4600-007	0.4818-007 / 0.1286-008
0 / 0.	0 / 0.	5 / 29.4	0 / 0.	3 / 17.6	6 / 35.3	0 / 0.	2 / 11.8	1 / 5.9	0 / 0.	IBG09	AMP	0.5300-007 / 0.4900-007	0.5047-007 / 0.1251-008
1 / 5.9	0 / 0.	0 / 0.	1 / 5.9	7 / 41.	7 / 41.	0 / 0.	1 / 5.9	0 / 0.	0 / 0.	IRC01	AMP	0.5200-007 / 0.4600-007	0.5024-007 / 0.1300-008
0 / 0.	1 / 5.9	1 / 5.9	1 / 5.9	0 / 0.	12 / 70.6	0 / 0.	1 / 5.9	1 / 5.9	0 / 0.	ICB01	AMP	0.5500-007 / 0.4800-007	0.5082-007 / 0.1074-008
0 / 0.	0 / 0.	3 / 17.6	0 / 0.	2 / 11.8	8 / 47.1	1 / 5.9	2 / 11.8	1 / 5.9	0 / 0.	IDG01	AMP	0.5200-007 / 0.4600-007	0.4894-007 / 0.1519-008
0 / 0.	1 / 5.9	2 / 11.8	0 / 0.	6 / 35.3	3 / 29.4	2 / 11.8	1 / 5.9	0 / 0.	0 / 0.	IDE01	AMP	0.5200-007 / 0.4000-007	0.4718-007 / 0.8107-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	7098	UGO	025 0	400	XG	17

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	4	0	2	7	3	1	0	0	IRG09	AMP	0.5200-007 / 0.4700-007	0.4959-007 / 0.1417-008
0.	0.	23.5	0.	11.8	41.2	17.6	5.9	0.	0.				
0	1	0	3	5	3	0	5	0	0	IGR04	AMP	0.5300-007 / 0.4700-007	0.5135-007 / 0.1579-008
0.	5.9	0.	17.6	29.4	17.6	0.	29.4	0.	0.				
0	0	5	0	8	0	2	1	1	0	IBR04	AMP	0.5600-007 / 0.5200-007	0.5312-007 / 0.1111-008
0.	0.	29.4	0.	47.1	0.	11.8	5.9	5.9	0.				
0	1	2	0	2	7	4	1	0	0	IRG02	AMP	0.5600-007 / 0.4700-007	0.5259-007 / 0.2033-008
0.	5.9	11.8	0.	11.8	41.2	23.5	5.9	0.	0.				
0	1	1	5	1	1	6	2	0	0	IGB02	AMP	0.5700-007 / 0.5000-007	0.5441-007 / 0.2004-008
0.	5.9	5.9	29.4	5.9	5.9	35.3	11.8	0.	0.				
0	0	1	7	1	3	0	5	0	0	IBG09	AMP	0.5400-007 / 0.4900-007	0.5135-007 / 0.1618-008
0.	0.	5.9	41.2	5.9	17.6	0.	29.4	0.	0.				
0	1	2	0	3	6	0	5	0	0	IRC01	AMP	0.5600-007 / 0.5000-007	0.5400-007 / 0.1732-008
0.	5.9	11.8	0.	17.6	35.3	0.	29.4	0.	0.				
0	0	4	0	3	3	6	1	0	0	ICB01	AMP	0.5700-007 / 0.5200-007	0.5471-007 / 0.1552-008
0.	0.	23.5	0.	17.6	17.6	35.3	5.9	0.	0.				
0	1	2	1	5	5	0	3	0	0	ICG01	AMP	0.5600-007 / 0.5000-007	0.5324-007 / 0.1562-008
0.	5.9	11.8	5.9	29.4	29.4	0.	17.6	0.	0.				
0	1	3	0	1	7	5	0	0	0	ICE01	AMP	0.5400-007 / 0.4400-007	0.5112-007 / 0.3295-008
0.	5.9	17.6	0.	5.9	41.2	29.4	0.	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R-518	D287	UGO	025 C	000	FE	21

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	1	0	2	0	0	17	0	1	0	0			
	4.8	0.	9.5	0.	0.	81.0	0.	4.8	0.	0.	IECOT	AMP	0.3400-007 / 0.3100-007	0.3286-007 / 0.9732-009
	0	0	0	4	10	4	1	1	0	1			
	0.	0.	0.	19.0	47.6	19.0	4.8	4.8	0.	4.8	IEBOT	AMP	0.2970-006 / 0.4700-007	0.9424-007 / 0.8867-007
	0	0	3	2	8	5	0	2	1	0			
	0.	0.	14.3	9.5	38.1	23.8	0.	9.5	4.8	0.	BTATL	AMP	0.8981-004 / 0.1017-004	0.3505-004 / 0.1902-004
	0	0	3	2	8	3	3	0	2	0			
	0.	0.	14.3	9.5	38.1	14.3	14.3	0.	9.5	0.	BTATW	AMP	0.2828-002 / 0.6830-003	0.1340-002 / 0.4014-003
	0	0	4	0	5	5	4	3	0	0			
	0.	0.	19.0	0.	23.8	23.8	19.0	14.3	0.	0.	ICBOC	AMP	0.5100-007 / 0.4700-007	0.4886-007 / 0.1382-008
	0	0	0	1	19	0	0	0	0	1			
	0.	0.	0.	4.8	90.5	0.	0.	0.	0.	4.8	ICEOC	AMP	0.4960-006 / 0.3000-006	0.6555-007 / 0.0005-007
	0	0	6	0	6	0	8	1	0	0			
	0.	0.	28.6	0.	28.6	0.	38.1	4.8	0.	0.	ICCOW	AMP	0.3600-007 / 0.3300-007	0.3417-007 / 0.0284-009
	0	0	0	6	7	5	2	0	0	1			
	0.	0.	0.	28.6	33.3	23.8	9.5	0.	0.	4.8	IEBOW	AMP	0.2870-006 / 0.4800-007	0.9995-007 / 0.9443-007
	0	0	0	5	10	2	1	1	2	0			
	0.	0.	0.	23.8	47.6	9.5	4.8	4.8	9.5	0.	BTACL	AMP	0.8637-004 / 0.1513-004	0.3226-004 / 0.2080-004
	0	0	0	7	7	2	1	3	1	0			
	0.	0.	0.	33.3	33.3	9.5	4.8	14.3	4.8	0.	BTACW	AMP	0.2800-002 / 0.7168-003	0.1334-002 / 0.6404-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4093	RS180	1318	UGO	025 C	340	XG	20

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	4	0	11	1	0	3	1	0	IECOT	AMP	0.3300E-007 / 0.2700E-007	0.2950E-007 / 0.1700E-008
0.	0.	20.0	0.	55.0	5.0	0.	15.0	5.0	0.			
0	0	0	4	10	4	0	1	0	1	IEBOT	AMP	0.2010E-006 / 0.4500E-007	0.9155E-007 / 0.8809E-007
0.	0.	0.	20.0	50.0	20.0	0.	5.0	0.	5.0			
0	0	1	4	8	4	0	2	1	0	BTATL	AMP	0.1059E-003 / 0.1222E-004	0.3803E-004 / 0.8200E-004
0.	0.	5.0	20.0	40.0	20.0	0.	10.0	5.0	0.			
0	0	3	2	7	5	1	0	2	0	BTATM	AMP	0.2819E-002 / 0.6758E-003	0.1355E-002 / 0.4068E-003
0.	0.	15.0	10.0	35.0	25.0	5.0	0.	10.0	0.			
0	1	2	3	3	6	3	2	0	0	IDBOS	AMP	0.5100E-007 / 0.3900E-007	0.4550E-007 / 0.8187E-008
0.	5.0	10.0	15.0	15.0	30.0	15.0	10.0	0.	0.			
0	0	0	0	19	0	0	0	0	1	IDEOS	AMP	0.9500E-006 / 0.4000E-007	0.7025E-007 / 0.1098E-006
0.	0.	0.	0.	95.0	0.	0.	0.	0.	5.0			
0	0	1	6	3	4	4	1	1	0	IECOS	AMP	0.3600E-007 / 0.2700E-007	0.3120E-007 / 0.2215E-008
0.	0.	5.0	30.0	15.0	20.0	20.0	5.0	5.0	0.			
0	0	2	4	6	2	4	1	1	0	IEBOS	AMP	0.2310E-006 / 0.4700E-007	0.9595E-007 / 0.4958E-007
0.	0.	10.0	20.0	30.0	10.0	20.0	5.0	5.0	0.			
0	0	0	5	9	2	1	2	1	0	BTACL	AMP	0.9769E-004 / 0.1798E-004	0.3935E-004 / 0.8403E-004
0.	0.	0.	25.0	45.0	10.0	5.0	10.0	5.0	0.			
0	0	1	5	7	3	0	3	1	0	BTACM	AMP	0.2740E-002 / 0.6996E-003	0.1339E-002 / 0.4372E-003
0.	0.	5.0	25.0	35.0	15.0	0.	15.0	5.0	0.			

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	2208	UGO	025 C	694	XG	18

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0 / 0	0 / 0	2 / 11.1	0 / 0	9 / 50.0	0 / 0	0 / 0	7 / 38.9	0 / 0	0 / 0	IECOT	AMP	0.4100-007 / 0.3900-007	0.4028-007 / 0.4691-009
0 / 0	0 / 0	0 / 0	3 / 16.7	10 / 55.6	3 / 16.7	0 / 0	1 / 5.6	0 / 0	1 / 5.6	IEBOT	AMP	0.3110-006 / 0.5400-007	0.1020-006 / 0.4264-007
0 / 0	0 / 0	1 / 5.6	4 / 22.2	7 / 38.9	3 / 16.7	0 / 0	2 / 11.1	1 / 5.6	0 / 0	BTATL	AMP	0.8975-004 / 0.1036-004	0.3571-004 / 0.2026-004
0 / 0	0 / 0	3 / 16.7	1 / 5.6	7 / 38.9	5 / 27.8	0 / 0	0 / 0	2 / 11.1	0 / 0	BTATW	AMP	0.2819-002 / 0.6682-003	0.1346-002 / 0.6208-003
0 / 0	0 / 0	1 / 5.6	4 / 22.2	5 / 27.8	1 / 5.6	5 / 27.8	2 / 11.1	0 / 0	0 / 0	ICBOG	AMP	0.6100-007 / 0.5500-007	0.5772-007 / 0.1742-008
0 / 0	0 / 0	0 / 0	0 / 0	17 / 94.4	0 / 0	0 / 0	0 / 0	0 / 0	1 / 5.6	ICEOG	AMP	0.3700-006 / 0.4200-007	0.7294-007 / 0.7422-007
0 / 0	1 / 5.6	0 / 0	6 / 33.3	0 / 0	7 / 38.9	0 / 0	4 / 22.2	0 / 0	0 / 0	IECOW	AMP	0.4500-007 / 0.4000-007	0.4175-007 / 0.8782-009
0 / 0	0 / 0	4 / 22.2	2 / 11.1	5 / 27.8	2 / 11.1	0 / 0	5 / 27.8	0 / 0	0 / 0	IEBOW	AMP	0.1610-006 / 0.5500-007	0.9722-007 / 0.3496-007
0 / 0	0 / 0	0 / 0	4 / 22.2	9 / 50.0	2 / 11.1	0 / 0	2 / 11.1	1 / 5.6	0 / 0	BTACL	AMP	0.8276-004 / 0.1518-004	0.3252-004 / 0.2108-004
0 / 0	0 / 0	1 / 5.6	4 / 22.2	7 / 38.9	2 / 11.1	0 / 0	3 / 16.7	1 / 5.6	0 / 0	BTACW	AMP	.2714- 2 / 0.6878-003	.1337- 2 / 0.6464-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4083	RB180	3078	UGO	025 0	10C	XG	17

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	NAME	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	1	4	0	0	12	0	0	0	0	IECOT	AMPI	0.4000E-007 / 0.3800E-007	0.3965E-007 / 0.6065E-009
0	5.9	23.5	0	0	70.6	0	0	0	0				
0	0	2	3	6	2	1	2	1	0	IEBOT	AMPI	0.1860E-006 / 0.9500E-007	0.9876E-007 / 0.8584E-007
0	0	11.8	17.6	35.3	11.8	5.9	11.8	5.9	0				
0	0	1	3	7	3	1	1	1	0	BTATLI	AMPI	0.1377E-003 / 0.1688E-004	0.5167E-004 / 0.3157E-004
0	0	5.9	17.6	41.2	17.6	5.9	5.9	5.9	0				
0	0	2	2	7	4	0	0	2	0	BTATWI	AMPI	0.2095E-002 / 0.6814E-003	0.1345E-003 / 0.6406E-003
0	0	11.8	11.8	41.2	23.5	0	0	11.8	0				
0	0	5	0	1	8	0	3	0	0	ICBOC	AMPI	0.5300E-007 / 0.4900E-007	0.5059E-007 / 0.1228E-008
0	0	29.4	0	5.9	47.1	0	17.6	0	0				
0	0	0	0	15	1	0	0	0	1	ICEOC	AMPI	0.5280E-006 / 0.4700E-007	0.5076E-007 / 0.1161E-006
0	0	0	0	88.2	5.9	0	0	0	5.9				
0	0	0	0	12	0	0	5	0	0	ICCOC	AMPI	0.4100E-007 / 0.4000E-007	0.4089E-007 / 0.4607E-009
0	0	0	0	70.6	0	0	29.4	0	0				
0	0	3	3	4	3	0	4	0	0	IEBOC	AMPI	0.1970E-006 / 0.9500E-007	0.9605E-007 / 0.3417E-007
0	0	17.6	17.6	23.5	17.6	0	23.5	0	0				
0	0	0	4	8	2	0	2	1	0	BTACLI	AMPI	0.1200E-003 / 0.2438E-004	0.5074E-004 / 0.3238E-004
0	0	0	23.5	47.1	11.8	0	11.8	5.9	0				
0	0	0	4	8	1	0	3	1	0	BTACWI	AMPI	0.2722E-002 / 0.6981E-003	0.1351E-003 / 0.6721E-003
0	0	0	23.5	47.1	5.9	0	17.6	5.9	0				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	7098	UGO	025 0	400	XG	17

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	6	0	0	5	0	6	0	0	IECOT	AMP	0.3900E-007 / 0.3700E-007	0.3800E-007 / 0.0660E-009
0.	0.	35.3	0.	0.	29.4	0.	35.3	0.	0.				
0	0	0	4	8	3	0	1	0	1	IEBOT	AMP	0.3000E-006 / 0.5400E-007	0.1046E-006 / 0.6267E-007
0.	0.	0.	23.5	47.1	17.6	0.	5.9	0.	5.9				
0	0	1	4	5	4	1	1	1	0	BTATL	AMP	0.1195E-003 / 0.1350E-004	0.4165E-004 / 0.2564E-004
0.	0.	5.9	23.5	29.4	23.5	5.9	5.9	5.9	0.				
0	0	3	1	6	5	0	1	1	0	BTATH	AMP	0.2909E-002 / 0.6970E-003	0.1410E-002 / 0.6493E-003
0.	0.	17.6	5.9	35.3	29.4	0.	5.9	5.9	0.				
0	0	1	4	4	5	0	2	1	0	IOBOC	AMP	0.6000E-007 / 0.5200E-007	0.5500E-007 / 0.2179E-008
0.	0.	5.9	23.5	23.5	29.4	0.	11.8	5.9	0.				
0	0	0	0	16	0	0	0	0	1	IGEOC	AMP	0.4200E-006 / 0.5200E-007	0.7710E-007 / 0.6982E-007
0.	0.	0.	0.	94.1	0.	0.	0.	0.	5.9				
0	0	0	9	0	1	0	7	0	0	IEGOB	AMP	0.4200E-007 / 0.4000E-007	0.4080E-007 / 0.9926E-009
0.	0.	0.	52.9	0.	5.9	0.	41.2	0.	0.				
0	0	4	2	4	2	0	5	0	0	IEBOB	AMP	0.1600E-006 / 0.5600E-007	0.1019E-006 / 0.3565E-007
0.	0.	23.5	11.8	23.5	11.8	0.	29.4	0.	0.				
0	0	0	3	9	2	0	2	1	0	BTAGL	AMP	0.7996E-004 / 0.1460E-004	0.3099E-004 / 0.2099E-004
0.	0.	0.	17.6	52.9	11.8	0.	11.8	5.9	0.				
0	0	1	3	7	2	0	4	0	0	BTAGH	AMP	0.2490E-002 / 0.6254E-003	0.1257E-002 / 0.6106E-003
0.	0.	5.9	17.6	41.2	11.8	0.	23.5	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R=518	D287	UGO	025 C	000	FE	21

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	1	0	2	0	4	12	1	1	0	0	IC1C2	AMP	0.4900-007	0.4605-007
	4.8	0.	9.5	0.	19.0	57.1	4.8	4.8	0.	0.			0.3900-007	0.2247-008
	0	0	2	7	0	7	0	5	0	0	IC2C1	AMP	0.4700-007	0.4571-007
	0.	0.	9.5	33.3	0.	33.3	0.	23.8	0.	0.			0.4400-007	0.9562-009
	0	0	0	0	19	0	0	0	0	2	IC6G0	AMP	0.1431-004	0.1474-005
	0.	0.	0.	0.	90.5	0.	0.	0.	0.	9.5			0.8700-007	0.4268-005
	0	0	0	9	4	5	0	1	2	0	BTACE	AMP	0.4986-004	0.1951-004
	0.	0.	0.	42.9	19.0	23.8	0.	4.8	9.5	0.			0.8663-005	0.1214-004
	0	0	4	1	7	6	0	1	2	0	BTATI	AMP	0.5177-004	0.2855-004
	0.	0.	19.0	4.8	33.3	28.6	0.	4.8	9.5	0.			0.8617-005	0.1171-004
	0	0	0	9	3	3	2	4	0	0	IDSL	AMP	0.3649-004	0.1343-004
	0.	0.	0.	42.9	14.3	14.3	9.5	19.0	0.	0.			0.1330-005	0.1234-004
	0	0	5	0	6	1	6	3	0	0	IDSH	AMP	0.7470-004	0.4466-004
	0.	0.	23.8	0.	28.6	4.8	28.6	14.3	0.	0.			0.8030-005	0.2183-004
	0	0	2	5	2	6	3	3	0	0	IL5	AMP	0.1190-006	0.1150-006
	0.	0.	9.5	23.8	9.5	28.6	14.3	14.3	0.	0.			0.1110-006	0.2179-008
	0	0	3	4	1	8	3	1	1	0	IL-12	AMP	0.1080-006	0.1028-006
	0.	0.	14.3	19.0	4.8	38.1	14.3	4.8	4.8	0.			0.9900-007	0.2358-008
	0	0	5	0	5	6	1	4	0	0	IL-11	AMP	0.1240-006	0.1190-006
	0.	0.	23.8	0.	23.8	28.6	4.8	19.0	0.	0.			0.1160-006	0.2625-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	RS180	1318	UGO	025 C	340	XG	20

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	3	3	5	3	2	4	0	0	IC1C2	AMP	0.4800-007 / 0.3600-007	0.4165-007 / 0.3513-008
0.	0.	15.0	15.0	25.0	15.0	10.0	20.0	0.	0.				
0	0	0	8	4	3	0	3	2	0	IC2C1	AMP	0.4800-007 / 0.3900-007	0.4175-007 / 0.3003-008
0.	0.	0.	40.0	20.0	15.0	0.	15.0	10.0	0.				
0	0	0	0	19	0	0	0	0	1	IC600	AMP	0.1429-004 / 0.9000-007	0.8139-006 / 0.8172-005
0.	0.	0.	0.	95.0	0.	0.	0.	0.	5.0				
0	0	0	8	6	3	0	1	2	0	STACK	AMP	0.5040-004 / 0.8705-005	0.2018-004 / 0.1240-004
0.	0.	0.	40.0	30.0	15.0	0.	5.0	10.0	0.				
0	0	4	1	6	6	0	1	2	0	STATI	AMP	0.5234-004 / 0.8728-005	0.2396-004 / 0.1215-004
0.	0.	20.0	5.0	30.0	30.0	0.	5.0	10.0	0.				
0	0	0	10	1	3	2	4	0	0	IDSL	AMP	0.3439-004 / 0.8900-006	0.1296-004 / 0.1217-004
0.	0.	0.	50.0	5.0	15.0	10.0	20.0	0.	0.				
0	0	4	2	4	2	5	3	0	0	IDSH	AMP	0.7267-004 / 0.7290-005	0.4305-004 / 0.8240-004
0.	0.	20.0	10.0	20.0	10.0	25.0	15.0	0.	0.				
0	1	2	3	1	9	0	4	0	0	ILB	AMP	0.1180-006 / 0.1090-006	0.1150-006 / 0.8162-008
0.	5.0	10.0	15.0	5.0	45.0	0.	20.0	0.	0.				
0	0	3	1	8	3	2	3	0	0	IL-12	AMP	0.1060-006 / 0.9600-007	0.1018-006 / 0.8238-008
0.	0.	15.0	5.0	40.0	15.0	10.0	15.0	0.	0.				
0	1	1	1	5	8	1	3	0	0	IL-11	AMP	0.1220-006 / 0.1110-006	0.1170-006 / 0.2624-008
0.	5.0	5.0	5.0	25.0	40.0	5.0	15.0	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L2083	A5180	2208	UGO	025 C	694	XG	18

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	1	1	3	5	5	0	2	1	0	ID1CE:	AMP:	0.6200-007 / 0.5822-007
0.	5.6	5.6	16.7	27.8	27.8	0.	11.1	5.6	0.			0.4900-007 / 0.8001-008
0	0	0	0	16	0	1	0	0	1	ID2CL:	AMP:	0.7600-006 / 0.1062-004
0.	0.	0.	0.	88.9	0.	5.6	0.	0.	5.6			0.5300-007 / 0.1695-006
0	0	0	0	16	0	0	0	2	0	ID6GD:	AMP:	0.1422-004 / 0.1765-005
0.	0.	0.	0.	88.9	0.	0.	0.	11.1	0.			0.7500-007 / 0.4536-005
0	0	0	7	6	2	0	2	1	0	BTACK:	AMP:	0.5024-004 / 0.2027-004
0.	0.	0.	38.9	33.3	11.1	0.	11.1	5.6	0.			0.8629-005 / 0.1275-004
0	0	3	1	7	4	1	0	2	0	BTATI:	AMP:	0.5219-004 / 0.2453-004
0.	0.	16.7	5.6	38.9	22.2	5.6	0.	11.1	0.			0.8695-005 / 0.1236-004
0	0	0	9	1	3	1	3	1	0	IDSLI	AMP:	0.4574-004 / 0.1354-004
0.	0.	0.	50.0	5.6	16.7	5.6	16.7	5.6	0.			0.1530-005 / 0.1355-004
0	0	3	2	4	2	5	2	0	0	IDSH:	AMP:	0.7985-004 / 0.4420-004
0.	0.	16.7	11.1	22.2	11.1	27.8	11.1	0.	0.			0.8000-005 / 0.2256-004
0	0	2	0	8	4	0	4	0	0	ILB:	AMP:	0.1360-006 / 0.1337-004
0.	0.	11.1	0.	44.4	22.2	0.	22.2	0.	0.			0.1520-006 / 0.1274-005
0	0	6	0	3	3	4	2	0	0	IL-1E:	AMP:	0.1220-006 / 0.1191-004
0.	0.	33.3	0.	16.7	16.7	22.2	11.1	0.	0.			0.1160-006 / 0.1907-005
0	0	2	3	5	1	4	3	0	0	IL-11:	AMP:	0.1410-006 / 0.1371-004
0.	0.	11.1	16.7	27.8	5.6	22.2	16.7	0.	0.			0.1530-006 / 0.2398-005

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4083	R5180	3078	UGO	025 C	100	XG	17

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	2	0	1	3	8	0	3	0	0	ID1C2	AMP	0.5200-007	0.4053-007
	0.	11.8	0.	5.9	17.6	47.1	0.	17.6	0.	0.			0.4400-007	0.2211-008
	1	0	0	0	0	14	2	0	0	0	ID2C1	AMP	0.5000-007	0.4679-007
	5.9	0.	0.	0.	0.	82.4	11.8	0.	0.	0.			0.2900-007	0.4711-008
	0	0	0	0	13	2	0	0	2	0	ID6G0	AMP	0.1423-004	0.2286-005
	0.	0.	0.	0.	76.5	11.8	0.	0.	11.8	0.			0.9600-007	0.4715-005
	0	0	0	7	5	2	0	2	1	0	BTACI	AMP	0.5043-004	0.2045-004
	0.	0.	0.	41.2	29.4	11.8	0.	11.8	5.9	0.			0.8720-005	0.1321-004
	0	0	3	1	7	3	1	1	1	0	BTATI	AMP	0.5250-004	0.2457-004
	0.	0.	17.6	5.9	41.2	17.6	5.9	5.9	5.9	0.			0.8759-005	0.1278-004
	0	0	0	7	2	3	2	2	1	0	IDSL	AMP	0.3580-004	0.1153-004
	0.	0.	0.	41.2	11.8	17.6	11.8	11.8	5.9	0.			0.3900-006	0.1167-004
	0	0	3	2	4	1	5	2	0	0	IDSH	AMP	0.7371-004	0.4213-004
	0.	0.	17.6	11.8	23.5	5.9	29.4	11.8	0.	0.			0.7290-005	0.2193-004
	0	1	2	0	6	3	3	2	0	0	IL5	AMP	0.1230-006	0.1205-006
	0.	5.9	11.8	0.	35.3	17.6	17.6	11.8	0.	0.			0.1170-006	0.1700-008
	0	0	2	4	1	5	3	2	0	0	IL-12	AMP	0.1070-006	0.1045-006
	0.	0.	11.8	23.5	5.9	29.4	17.6	11.8	0.	0.			0.1010-006	0.1736-008
	0	0	2	3	4	1	3	4	0	0	IL-11	AMP	0.1270-006	0.1242-006
	0.	0.	11.8	17.6	23.5	5.9	17.6	23.5	0.	0.			0.1210-006	0.2270-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	7098	UGO	825 G	40G	XG	17

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	1	2	0	5	5	1	3	0	0	IC1G2	AMP	0.5600E-007 / 0.4800E-007	0.5241E-007 / 0.2152E-008
	0.	5.9	11.8	0.	29.4	29.4	5.9	17.6	0.	0.				
	0	1	1	0	4	3	7	1	0	0	IC2C1	AMP	0.5400E-007 / 0.4700E-007	0.5188E-007 / 0.1654E-008
	0.	5.9	5.9	0.	23.5	17.6	41.2	5.9	0.	0.				
	0	0	0	0	15	0	0	1	0	1	IG6GG	AMP	0.1438E-004 / 0.9300E-007	0.1398E-005 / 0.3649E-008
	0.	0.	0.	0.	88.2	0.	0.	5.9	0.	5.9				
	0	0	0	6	6	2	0	2	1	0	BTAGI	AMP	0.5046E-004 / 0.8730E-005	0.2098E-004 / 0.1297E-004
	0.	0.	0.	35.3	35.3	11.8	0.	11.8	5.9	0.				
	0	0	3	1	6	4	1	1	1	0	BTATI	AMP	0.5254E-004 / 0.8820E-005	0.2488E-004 / 0.1275E-004
	0.	0.	17.6	5.9	35.3	23.5	5.9	5.9	5.9	0.				
	0	0	3	5	1	3	2	3	0	0	IDSL	AMP	0.3290E-004 / 0.4700E-006	0.1235E-004 / 0.1091E-004
	0.	0.	17.6	29.4	5.9	17.6	11.8	17.6	0.	0.				
	0	0	4	1	3	2	5	2	0	0	IDSH	AMP	0.7192E-004 / 0.6900E-005	0.4265E-004 / 0.2245E-004
	0.	0.	23.5	5.9	17.6	11.8	29.4	11.8	0.	0.				
	0	0	3	1	3	3	6	1	0	0	IL5	AMP	0.1050E-006 / 0.9700E-007	0.1015E-006 / 0.2717E-008
	0.	0.	17.6	5.9	17.6	17.6	35.3	5.9	0.	0.				
	0	0	5	0	1	6	3	2	0	0	IL-12	AMP	0.9400E-007 / 0.8400E-007	0.9041E-007 / 0.3261E-008
	0.	0.	29.4	0.	5.9	35.3	17.6	11.8	0.	0.				
	0	0	4	0	3	3	6	1	0	0	IL-11	AMP	0.1110E-006 / 0.1030E-006	0.1075E-006 / 0.2939E-008
	0.	0.	23.5	0.	17.6	17.6	35.3	5.9	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4083	R-918	0887	00	025 C	ENV	PE	33

	*3STD	*2STD	*1STD	*.67STD	MEAN	*.67STD	*1STD	*2STD	*3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	1	0	0	0	11	15	5	1	0	0			
	3.0	0.	0.	0.	33.3	45.5	15.2	3.0	0.	0.			
IRG09											AMP	0.4800-007	0.4459-007
												0.3000-007	0.3022-008
	1	0	3	0	16	3	0	10	0	0			
	3.0	0.	9.1	0.	48.5	9.1	0.	30.3	0.	0.			
IBR04											AMP	0.4900-007	0.4745-007
												0.4300-007	0.1348-008
	0	0	6	0	6	13	0	7	1	0			
	0.	0.	18.2	0.	18.2	39.4	0.	21.2	3.0	0.			
IRB04											AMP	0.5100-007	0.4873-007
												0.4700-007	0.1098-008
	0	1	1	11	0	8	8	4	0	0			
	0.	3.0	3.0	33.3	0.	24.2	24.2	12.1	0.	0.			
IRB02											AMP	0.4800-007	0.4600-007
												0.4300-007	0.1225-008
	0	0	5	0	16	5	0	5	2	0			
	0.	0.	15.2	0.	48.5	15.2	0.	15.2	6.1	0.			
IBB02											AMP	0.5000-007	0.4748-007
												0.4600-007	0.1121-008
	1	0	4	0	9	12	0	7	0	0			
	3.0	0.	12.1	0.	27.3	36.4	0.	21.2	0.	0.			
IBG09											AMP	0.4800-007	0.4650-007
												0.4300-007	0.1146-008
	0	0	2	7	16	3	0	4	0	1			
	0.	0.	6.1	21.2	48.5	9.1	0.	12.1	0.	3.0			
IRC01											AMP	0.5500-007	0.4721-007
												0.4500-007	0.1916-008
	0	1	1	5	17	0	4	5	0	0			
	0.	3.0	3.0	15.2	51.5	0.	12.1	15.2	0.	0.			
IDB01											AMP	0.4900-007	0.4712-007
												0.4400-007	0.1139-008
	0	1	7	0	6	11	4	4	0	0			
	0.	3.0	21.2	0.	18.2	33.3	12.1	12.1	0.	0.			
IDG01											AMP	0.4900-007	0.4664-007
												0.4300-007	0.1432-008
	0	0	0	0	30	0	1	0	0	2			
	0.	0.	0.	0.	90.9	0.	3.0	0.	0.	6.1			
IDE01											AMP	0.4000-006	0.7081-007
												0.3000-007	0.6784-007

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	M518N	1308	GQ	025 0	340	XG	32

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	5	4	7	8	3	4	1	0	IRG09	AMP	0.5000-007	0.4259-007
0.	0.	15.6	12.5	21.9	25.0	9.4	12.5	3.1	0.			0.3900-007	0.2734-008
0	0	7	2	5	10	2	5	1	0	IBR04	AMP	0.5100-007	0.4469-007
0.	0.	21.9	6.2	15.6	31.2	6.2	15.6	3.1	0.			0.4000-007	0.2890-008
0	2	3	2	11	7	4	3	0	0	IBR04	AMP	0.5200-007	0.4622-007
0.	6.2	9.4	6.2	34.4	21.9	12.5	9.4	0.	0.			0.3900-007	0.3024-008
0	0	6	1	7	11	2	4	1	0	IRB02	AMP	0.5200-007	0.4481-007
0.	0.	18.7	3.1	21.9	34.4	6.2	12.5	3.1	0.			0.3900-007	0.2967-008
0	1	5	0	7	7	6	6	0	0	IGB02	AMP	0.5100-007	0.4581-007
0.	3.1	15.6	0.	21.9	21.9	18.7	18.7	0.	0.			0.3900-007	0.3146-008
0	0	7	0	5	14	3	2	1	0	IBG09	AMP	0.5200-007	0.4491-007
0.	0.	21.9	0.	15.6	43.7	9.4	6.2	3.1	0.			0.3900-007	0.3166-008
0	0	6	0	11	5	5	5	0	0	IRC01	AMP	0.5100-007	0.4509-007
0.	0.	18.7	0.	34.4	15.6	15.6	15.6	0.	0.			0.3900-007	0.3236-008
0	2	3	3	8	10	2	3	1	0	ICB01	AMP	0.5200-007	0.4516-007
0.	6.2	9.4	9.4	25.0	31.2	6.2	9.4	3.1	0.			0.3900-007	0.3017-008
0	0	6	4	4	12	1	5	0	0	IDG01	AMP	0.4900-007	0.4563-007
0.	0.	18.7	12.5	12.5	37.5	3.1	15.6	0.	0.			0.3900-007	0.2904-008
0	0	0	0	29	0	1	0	0	2	IDE01	AMP	0.4760-006	0.7203-007
0.	0.	0.	0.	90.6	0.	3.1	0.	0.	6.2			0.3500-007	0.1013-006

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R518N	2208	GO	025 C	694	XG	31

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	5	3	8	7	0	7	1	0	IRQ09	AMP	0.5900-007	0.5539-007
0.	0.	16.1	9.7	25.8	22.6	0.	22.6	3.2	0.			0.5300-007	0.1520-008
0	1	2	6	8	8	0	6	0	0	IGR04	AMP	0.5900-007	0.5639-007
0.	3.2	6.5	19.4	25.8	25.8	0.	19.4	0.	0.			0.5300-007	0.1585-008
0	0	0	0	30	0	0	0	0	1	IBR04	AMP	0.8560-006	0.9374-007
0.	0.	0.	0.	96.8	0.	0.	0.	0.	3.2			0.5500-007	0.1433-006
0	0	0	0	30	0	0	0	0	1	IRB02	AMP	0.8950-006	0.9274-007
0.	0.	0.	0.	96.8	0.	0.	0.	0.	3.2			0.5300-007	0.1506-006
1	0	0	5	13	3	7	2	0	0	IBB02	AMP	0.6100-007	0.5703-007
3.2	0.	0.	16.1	41.9	9.7	22.6	6.5	0.	0.			0.4700-007	0.2442-008
0	1	1	8	9	0	10	2	0	0	IBQ09	AMP	0.5800-007	0.5603-007
0.	3.2	3.2	25.8	29.0	0.	32.3	6.5	0.	0.			0.5300-007	0.1140-008
0	0	5	0	9	7	7	2	1	0	IRC01	AMP	0.5900-007	0.5577-007
0.	0.	16.1	0.	29.0	22.6	22.6	6.5	3.2	0.			0.5300-007	0.1481-008
0	1	2	10	7	7	0	1	3	0	ICB01	AMP	0.5900-007	0.5603-007
0.	3.2	6.5	32.3	22.6	22.6	0.	3.2	9.7	0.			0.5300-007	0.1472-008
0	1	7	0	5	8	4	6	0	0	ICQ01	AMP	0.5800-007	0.5481-007
0.	3.2	22.6	0.	16.1	25.8	12.9	19.4	0.	0.			0.5100-007	0.1642-008
0	0	0	0	28	1	0	0	0	2	ICE01	AMP	0.4600-006	0.9065-007
0.	0.	0.	0.	90.3	3.2	0.	0.	0.	6.5			0.3100-007	0.9665-007

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R518N	3078	GO	025 C	10C	XG	31

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
1	1	0	3	10	13	2	0	1	0	IRG09	AMP	0.5700-007	0.4919-007
3.2	3.2	0.	9.7	32.3	41.9	6.5	0.	3.2	0.			0.3900-007	0.8994-008
0	1	1	0	16	9	0	2	2	0	IBR04	AMP	0.5000-007	0.4752-007
0.	3.2	3.2	0.	51.6	29.0	0.	6.5	6.5	0.			0.4500-007	0.1029-008
0	0	4	5	0	13	0	8	1	0	IBR04	AMP	0.5100-007	0.4890-007
0.	0.	12.9	16.1	0.	41.9	0.	25.8	3.2	0.			0.4700-007	0.1044-008
0	2	0	0	16	5	0	8	0	0	IRB02	AMP	0.5000-007	0.4765-007
0.	6.5	0.	0.	51.6	16.1	0.	25.8	0.	0.			0.4500-007	0.1253-008
0	0	3	3	18	0	2	4	1	0	IGB02	AMP	0.5200-007	0.4913-007
0.	0.	9.7	9.7	58.1	0.	6.5	12.9	3.2	0.			0.4700-007	0.1176-008
0	1	8	0	2	13	0	7	0	0	IBG09	AMP	0.5200-007	0.5055-007
0.	3.2	25.8	0.	6.5	41.9	0.	22.6	0.	0.			0.4800-007	0.1207-008
0	2	3	0	3	13	8	2	0	0	IRC01	AMP	0.5300-007	0.5087-007
0.	6.5	9.7	0.	9.7	41.9	25.8	6.5	0.	0.			0.4700-007	0.1360-008
0	0	5	5	0	13	5	3	0	0	ICB01	AMP	0.5300-007	0.5087-007
0.	0.	16.1	16.1	0.	41.9	16.1	9.7	0.	0.			0.4900-007	0.1176-008
0	0	5	0	8	4	11	3	0	0	ICG01	AMP	0.5200-007	0.4987-007
0.	0.	16.1	0.	25.8	12.9	35.5	9.7	0.	0.			0.4700-007	0.1477-008
0	0	0	0	28	0	1	0	0	2	ICE01	AMP	0.4600-006	0.7658-007
0.	0.	0.	0.	90.3	0.	3.2	0.	0.	6.5			0.3900-007	0.6921-007

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	7098	GO	025 G	406	XG	31

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	7	2	2	14	4	1	1	0	IRG09	AMP	0.5300*007 / 0.4600*007	0.4926*007 / 0.1847*008
0.	0.	22.6	6.5	6.5	45.2	12.9	3.2	3.2	0.			
0	0	10	0	4	8	0	9	0	0	IGR04	AMP	0.5300*007 / 0.5000*007	0.5152*007 / 0.1235*008
0.	0.	32.3	0.	12.9	25.8	0.	29.0	0.	0.			
0	0	8	0	5	7	7	4	0	0	IBR04	AMP	0.5400*007 / 0.5000*007	0.5281*007 / 0.1721*008
0.	0.	25.8	0.	16.1	22.6	22.6	12.9	0.	0.			
0	1	3	5	10	7	0	5	0	0	IRB02	AMP	0.5400*007 / 0.4900*007	0.5318*007 / 0.1721*008
0.	3.2	9.7	16.1	32.3	22.6	0.	16.1	0.	0.			
0	1	6	0	10	4	0	10	0	0	IGB02	AMP	0.5700*007 / 0.5000*007	0.5419*007 / 0.1797*008
0.	3.2	19.4	0.	32.3	12.9	0.	32.3	0.	0.			
0	1	1	11	2	9	0	7	0	0	IBG09	AMP	0.5400*007 / 0.4700*007	0.5123*007 / 0.1647*008
0.	3.2	3.2	35.5	6.5	29.0	0.	22.6	0.	0.			
0	0	6	5	6	3	9	1	1	0	IRG01	AMP	0.6000*007 / 0.5200*007	0.5448*007 / 0.1893*008
0.	0.	19.4	16.1	19.4	9.7	29.0	3.2	3.2	0.			
0	0	5	4	6	3	12	1	0	0	IGG01	AMP	0.5700*007 / 0.5200*007	0.5458*007 / 0.1589*008
0.	0.	16.1	12.9	19.4	9.7	38.7	3.2	0.	0.			
0	0	3	7	4	7	1	9	0	0	IBG01	AMP	0.5400*007 / 0.5000*007	0.5365*007 / 0.1962*008
0.	0.	9.7	22.6	12.9	22.6	3.2	29.0	0.	0.			
0	0	0	0	28	0	1	0	0	2	IGE01	AMP	0.4870*006 / 0.3500*007	0.8118*007 / 0.1029*006
0.	0.	0.	0.	90.3	0.	3.2	0.	0.	6.5			

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L40B3	R-518	D287	GO	025 C	ENV	FE	33

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	9	0	13	0	8	3	0	0	IECOT	AMP	0.3400-007
0.	0.	27.3	0.	39.4	0.	24.2	9.1	0.	0.		0.3100-007	0.0395-009
0	0	0	0	23	9	0	0	0	1	IEBOT	AMP	0.9450-006
0.	0.	0.	0.	69.7	27.3	0.	0.	0.	3.0		0.4500-007	0.2548-006
0	0	4	3	16	3	2	4	0	1	BTATLI	AMP	0.1014-003
0.	0.	12.1	9.1	48.5	9.1	6.1	12.1	0.	3.0		0.1099-004	0.2045-004
0	0	6	1	16	3	0	6	1	0	BTATMI	AMP	0.2758-002
0.	0.	18.2	3.0	48.5	9.1	0.	18.2	3.0	0.		0.5129-003	0.6978-003
0	0	4	4	14	3	0	7	1	0	IOBOO	AMP	0.5800-007
0.	0.	12.1	12.1	42.4	9.1	0.	21.2	3.0	0.		0.4700-007	0.2547-008
0	0	1	1	29	0	0	1	0	1	IOEOO	AMP	0.2200-006
0.	0.	3.0	3.0	87.9	0.	0.	3.0	0.	3.0		0.1000-008	0.9420-007
0	0	14	0	0	12	0	7	0	0	IECOO	AMP	0.3500-007
0.	0.	42.4	0.	0.	36.4	0.	21.2	0.	0.		0.3300-007	0.9809-009
0	0	0		4		0	3	1	1	IEBOO	AMP	0.3000-006
0.	0.	0.	6.1	72.7	6.1	0.	9.1	3.0	3.0		0.4300-007	0.5925-007
0	0	4	6	10	6	1	4	2	0	BTACLI	AMP	0.8743-004
0.	0.	12.1	18.2	30.3	18.2	3.0	12.1	6.1	0.		0.1284-004	0.3030-004
0	0	7	1	15	3	1	4	2	0	BTACMI	AMP	0.2727-002
0.	0.	21.2	3.0	45.5	9.1	3.0	12.1	6.1	0.		0.5660-003	0.6656-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
LADBS	RB1 N	130	GQ	025 C	340	XG	32

*3STD	*2STD	*1STD	*.67STD	MEAN	*.67STD	*1STD	*2STD	*3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	2	4	0	7	13	0	5	1	0	IECOT	AMP	0.3400-007	0.3000-007
0.	6.2	12.5	0.	21.9	40.6	0.	15.6	3.1	0.			0.2600-007	0.1967-008
0	0	0	8	14	1	4	4	1	0	IEBOT	AMP	0.1760-006	0.7634-007
0.	0.	0.	25.0	43.7	3.1	12.5	12.5	3.1	0.			0.4300-007	0.8487-007
0	0	4	3	15	3	0	6	0	1	BTATL	AMP	0.1143-003	0.3862-004
0.	0.	12.5	9.4	46.9	9.4	0.	18.7	0.	3.1			0.1267-004	0.2358-004
0	0	5	2	16	2	0	6	1	0	BTATM	AMP	0.2704-002	0.1284-002
0.	0.	15.6	6.2	50.0	6.2	0.	18.7	3.1	0.			0.5009-003	0.6979-003
0	1	4	1	11	8	4	3	0	0	IDBOC	AMP	0.5200-007	0.4603-007
0.	3.1	12.5	3.1	34.4	25.0	12.5	9.4	0.	0.			0.3900-007	0.8258-008
0	0	1	2	25	2	0	1	0	1	IDEOC	AMP	0.2310-006	0.4903-007
0.	0.	3.1	6.2	78.1	6.2	0.	3.1	0.	3.1			0.2000-008	0.3610-007
0	1	1	6	4	14	0	6	0	0	IECOB	AMP	0.3500-007	0.3097-007
0.	3.1	3.1	18.7	12.5	43.7	0.	18.7	0.	0.			0.2600-007	0.8024-008
0	0	0	0	26	1	0	3	1	1	IEBOB	AMP	0.2990-006	0.8228-007
0.	0.	0.	0.	81.2	3.1	0.	9.4	3.1	3.1			0.4500-007	0.9884-007
0	0	4	6	9	7	0	5	1	0	BTACL	AMP	0.9750-004	0.3989-004
0.	0.	12.5	18.7	28.1	21.9	0.	15.6	3.1	0.			0.1441-004	0.2195-004
0	0	7	1	13	4	1	5	1	0	BTACM	AMP	0.2640-002	0.1271-002
0.	0.	21.9	3.1	40.6	12.5	3.1	15.6	3.1	0.			0.5469-003	0.4499-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4083	R518N	2208	GO	025 C	694	XG	31

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	BARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	0	3	0	18	0	0	10	0	0	IECOT	AMP	0.4100-007	0.4023-007
	0.	0.	9.7	0.	58.1	0.	0.	32.3	0.	0.			0.3900-007	0.6170-009
	0	0	0	8	13	1	4	4	1	0	IEBOT	AMP	0.1850-006	0.8648-007
	0.	0.	0.	25.8	41.9	3.2	12.9	12.9	3.2	0.			0.5200-007	0.8556-007
	0	0	4	3	14	3	2	4	0	1	BTATL	AMP	0.9892-004	0.3348-004
	0.	0.	12.9	9.7	45.2	9.7	6.5	12.9	0.	3.2			0.1089-004	0.2060-004
	0	0	6	1	15	2	0	6	1	0	BTATH	AMP	0.2689-002	0.1290-002
	0.	0.	19.4	3.2	48.4	6.5	0.	19.4	3.2	0.			0.5003-003	0.6981-003
	0	0	8	0	8	4	0	11	0	0	ICBOC	AMP	0.5900-007	0.5745-007
	0.	0.	25.8	0.	25.8	12.9	0.	35.5	0.	0.			0.5500-007	0.1454-008
	0	0	2	1	24	3	0	0	0	1	ICEOC	AMP	0.1830-006	0.5832-007
	0.	0.	6.5	3.2	77.4	9.7	0.	0.	0.	3.2			0.2100-007	0.2502-007
	0	1	0	11	0	17	0	0	2	0	IECOS	AMP	0.4300-007	0.4165-007
	0.	3.2	0.	35.5	0.	54.8	0.	0.	6.5	0.			0.4000-007	0.6607-009
	0	0	0	1	23	2	0	3	1	1	IEBOS	AMP	0.3830-006	0.7361-007
	0.	0.	0.	3.2	74.2	6.5	0.	9.7	3.2	3.2			0.5100-007	0.6182-007
	0	0	4	6	8	6	1	5	1	0	BTACL	AMP	0.8164-004	0.3423-004
	0.	0.	12.9	19.4	25.8	19.4	3.2	16.1	3.2	0.			0.1197-004	0.1892-004
	0	0	7	1	14	2	1	5	1	0	BTACH	AMP	0.2611-002	0.1268-002
	0.	0.	22.6	3.2	45.2	6.5	3.2	16.1	3.2	0.			0.5435-003	0.4485-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R518N	3078	GO	025 C	100	XG	31

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
1	0	6	0	0	21	0	3	0	0	IECOT	AMP	0.4100-007
3.2	0.	19.4	0.	0.	67.7	0.	9.7	0.	0.		0.3700-007	0.9492-009
0	0	0	9	12	1	4	4	1	0	IEBOT	AMP	0.1850-006
0.	0.	0.	29.0	38.7	3.2	12.9	12.9	3.2	0.		0.5100-007	0.8510-007
0	0	4	3	14	3	1	5	0	1	BTATL	AMP	0.1462-003
0.	0.	12.9	9.7	45.2	9.7	3.2	16.1	0.	3.2		0.1700-004	0.8076-004
0	0	6	1	15	2	0	6	1	0	BTATH	AMP	0.2724-002
0.	0.	19.4	3.2	48.4	6.5	0.	19.4	3.2	0.		0.5143-003	0.7014-003
0	0	8	0	1	15	4	2	1	0	ICBOO	AMP	0.5400-007
0.	0.	25.8	0.	3.2	48.4	12.9	6.5	3.2	0.		0.4800-007	0.1437-008
0	0	1	2	26	0	0	1	0	1	ICEOO	AMP	0.2380-006
0.	0.	3.2	6.5	83.9	0.	0.	3.2	0.	3.2		0.6000-008	0.8730-007
0	1	0	0	18	0	0	12	0	0	ICCOB	AMP	0.4100-007
0.	3.2	0.	0.	58.1	0.	0.	38.7	0.	0.		0.3900-007	0.8507-009
0	0	0	1	24	1	0	3	1	1	ICEOB	AMP	0.3170-006
0.	0.	0.	3.2	77.4	3.2	0.	9.7	3.2	3.2		0.5100-007	0.4166-007
0	0	4	5	9	7	0	5	1	0	BTACL	AMP	0.1231-003
0.	0.	12.9	16.1	29.0	22.6	0.	16.1	3.2	0.		0.1903-004	0.8818-004
0	0	7	1	12	4	1	5	1	0	BTACH	AMP	0.2633-002
0.	0.	22.6	3.2	38.7	12.9	3.2	16.1	3.2	0.		0.5534-003	0.6489-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	7898	GO	025 G	400	XG	31

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	9	0	9	7	0	4	2	0	IEGOT	AMP	0.4190-007 / 0.3700-007	0.3830-007 / 0.1230-008
0.	0.	29.0	0.	29.0	22.6	0.	12.9	6.5	0.			
0	0	0	9	12	1	4	4	1	0	IEBOT	AMP	0.1870-006 / 0.5200-007	0.8713-007 / 0.3625-007
0.	0.	0.	29.0	38.7	3.2	12.9	12.9	3.2	0.			
0	0	3	4	14	3	1	5	0	1	BTATL	AMP	0.1262-003 / 0.1337-004	0.4097-004 / 0.2583-004
0.	0.	9.7	12.9	45.2	9.7	3.2	16.1	0.	3.2			
0	0	5	2	16	1	0	7	0	0	BTATH	AMP	0.2758-002 / 0.5135-003	0.1327-002 / 0.7262-003
0.	0.	16.1	6.5	51.6	3.2	0.	22.6	0.	0.			
0	0	0	5	17	1	2	6	0	0	ICBOG	AMP	0.6000-007 / 0.5200-007	0.5481-007 / 0.2868-008
0.	0.	0.	16.1	54.8	3.2	6.5	19.4	0.	0.			
0	0	1	2	26	0	0	1	0	1	ICEOG	AMP	0.2280-006 / 0.1300-007	0.5706-007 / 0.3449-007
0.	0.	3.2	6.5	83.9	0.	0.	3.2	0.	3.2			
0	0	0	19	0	3	0	9	0	0	IEGOB	AMP	0.4240-007 / 0.4000-007	0.4068-007 / 0.9087-009
0.	0.	0.	61.3	0.	9.7	0.	29.0	0.	0.			
0	0	0	0	24	2	1	1	2	1	IEBOB	AMP	0.3340-006 / 0.5200-007	0.9881-007 / 0.6980-007
0.	0.	0.	0.	77.4	6.5	3.2	3.2	6.5	3.2			
0	0	2	8	10	5	0	5	1	0	BTAGL	AMP	0.7280-004 / 0.1059-004	0.2969-004 / 0.1722-004
0.	0.	6.5	25.8	32.3	16.1	0.	16.1	3.2	0.			
0	0	6	2	15	1	1	5	1	0	BTAGH	AMP	0.2373-002 / 0.4910-003	0.1148-002 / 0.5966-003
0.	0.	19.4	6.5	48.4	3.2	3.2	16.1	3.2	0.			

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R-518	D287	GO	025 C	ENV	FE	33

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0 / 0.	0 / 0.	3 / 9.1	7 / 21.2	15 / 45.5	0 / 0.	3 / 9.1	4 / 12.1	1 / 3.0	0 / 0.	IC1C2	AMP	0.5000-007 / 0.4500-007	0.4703-007 / 0.1212-008
1 / 3.0	0 / 0.	5 / 15.2	0 / 0.	16 / 48.5	0 / 0.	10 / 30.3	0 / 0.	1 / 3.0	0 / 0.	IC2C1	AMP	0.4800-007 / 0.4300-007	0.4612-007 / 0.9273-009
0 / 0.	0 / 0.	0 / 0.	0 / 0.	26 / 78.8	0 / 0.	0 / 0.	7 / 21.2	0 / 0.	0 / 0.	IC6GO	AMP	0.1431-004 / 0.1050-006	0.1138-005 / 0.5887-005
0 / 0.	0 / 0.	1 / 3.0	7 / 21.2	14 / 42.4	4 / 12.1	1 / 3.0	3 / 9.1	3 / 9.1	0 / 0.	STACK	AMP	0.5291-004 / 0.5431-005	0.1971-004 / 0.1396-004
0 / 0.	0 / 0.	1 / 3.0	10 / 30.3	12 / 36.4	3 / 9.1	0 / 0.	5 / 15.2	2 / 6.1	0 / 0.	STATE	AMP	0.5711-004 / 0.8962-005	0.2425-004 / 0.1392-004
0 / 0.	0 / 0.	0 / 0.	5 / 15.2	17 / 51.5	4 / 12.1	4 / 12.1	1 / 3.0	0 / 0.	2 / 6.1	IDSLI	AMP	0.3767-004 / 0.3400-006	0.9007-005 / 0.9028-005
0 / 0.	0 / 0.	6 / 18.2	2 / 6.1	10 / 30.3	5 / 15.2	4 / 12.1	4 / 12.1	2 / 6.1	0 / 0.	IDSH	AMP	0.7502-004 / 0.9220-005	0.3675-004 / 0.1852-004
0 / 0.	2 / 6.1	4 / 12.1	1 / 3.0	4 / 12.1	17 / 51.5	1 / 3.0	4 / 12.1	0 / 0.	0 / 0.	IL5	AMP	0.1190-006 / 0.1110-006	0.1158-006 / 0.2270-008
0 / 0.	0 / 0.	5 / 15.2	2 / 6.1	7 / 21.2	12 / 36.4	3 / 9.1	4 / 12.1	0 / 0.	0 / 0.	IL-12	AMP	0.1050-006 / 0.1000-006	0.1040-006 / 0.2016-008
0 / 0.	1 / 3.0	7 / 21.2	0 / 0.	8 / 24.2	7 / 21.2	4 / 12.1	6 / 18.2	0 / 0.	0 / 0.	IL-11	AMP	0.1250-006 / 0.1160-006	0.1203-006 / 0.2096-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4083	RS18N	1308	0	025 C	340	X	32

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	MEGH VALUE LOW VALUE	MEAN STD
0	1	6	2	9	3	2	9	0	0	IC1CB	AMP	0.4800-007 / 0.3500-007	0.4247-007 / 0.8560-008
0.	3.1	18.7	6.2	28.1	9.4	6.2	28.1	0.	0.			
0	0	5	6	3	9	3	6	0	0	IC2CL	AMP	0.4800-007 / 0.3900-007	0.4356-007 / 0.8918-008
0.	0.	15.6	18.7	9.4	28.1	9.4	18.7	0.	0.			
0	0	0	0	25	0	0	7	0	0	IC4GB	AMP	0.1428-004 / 0.9700-007	0.3222-005 / 0.8946-005
0.	0.	0.	0.	78.1	0.	0.	21.9	0.	0.			
0	0	1	7	13	4	1	3	3	0	BTACK	AMP	0.5326-004 / 0.5443-005	0.1988-004 / 0.1428-004
0.	0.	3.1	21.9	40.6	12.5	3.1	9.4	9.4	0.			
0	0	1	10	11	3	0	5	2	0	BFATX	AMP	0.5749-004 / 0.8978-005	0.2466-004 / 0.1417-004
0.	0.	3.1	31.2	34.4	9.4	0.	15.6	6.2	0.			
0	0	0	6	16	3	2	4	0	1	IDBL	AMP	0.3488-004 / 0.3600-006	0.6630-005 / 0.4999-005
0.	0.	0.	18.7	50.0	9.4	6.2	12.5	0.	3.1			
0	0	0	2	10	4	4	5	1	0	IDSH	AMP	0.7327-004 / 0.8650-005	0.3450-004 / 0.2723-004
0.	0.	18.7	6.2	31.2	12.5	12.5	15.6	3.1	0.			
0	0	8	2	1	13	4	4	0	0	ILB	AMP	0.1190-006 / 0.1070-006	0.1158-006 / 0.5841-008
0.	0.	25.0	6.2	3.1	40.6	12.5	12.5	0.	0.			
0	2	3	3	7	8	3	6	0	0	IL-1N	AMP	0.1080-006 / 0.9100-007	0.1013-006 / 0.4417-008
0.	6.2	9.4	9.4	21.9	25.0	9.4	18.7	0.	0.			
0	0	6	2	6	7	6	5	0	0	IL-1L	AMP	0.1250-006 / 0.1080-006	0.1166-006 / 0.4425-008
0.	0.	18.7	6.2	18.7	21.9	18.7	15.6	0.	0.			

FAMILY	TYPE	DATE	TEST NO.	TEMP.	TIME	TEST	SET SIZE
L4093	R518N	2208	GQ	025 C	694	XG	31

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	1	3	5	0	14	0	8	0	0	IC1C2	AMPI	0.5700-007 / 0.5300-007	0.5581-007 / 0.1046-008
0.	3.2	9.7	16.1	0.	45.2	0.	25.8	0.	0.				
0	0	0	0	24	3	1	1	1	1	IC2C1	AMPI	0.9950-006 / 0.3000-008	0.1546-006 / 0.8547-006
0.	0.	0.	0.	77.4	9.7	3.2	3.2	3.2	3.2				
0	0	0	0	23	0	0	8	0	0	IC6GD	AMPI	0.1422-004 / 0.3400-007	0.4066-005 / 0.6134-005
0.	0.	0.	0.	74.2	0.	0.	25.8	0.	0.				
0	0	1	7	12	4	1	3	3	0	BTACI	AMPI	0.5315-004 / 0.5412-005	0.2008-004 / 0.1442-004
0.	0.	3.2	22.6	38.7	12.9	3.2	9.7	9.7	0.				
0	0	1	9	11	3	0	5	2	0	BTATI	AMPI	0.5740-004 / 0.8953-005	0.2499-004 / 0.1420-004
0.	0.	3.2	29.0	35.5	9.7	0.	16.1	6.5	0.				
0	0	0	7	15	2	3	3	0	1	IDSL	AMPI	0.3713-004 / 0.2300-006	0.6993-005 / 0.9586-005
0.	0.	0.	22.6	48.4	6.5	9.7	9.7	0.	3.2				
0	0	6	1	9	6	2	6	1	0	IDS	AMPI	0.7451-004 / 0.8420-005	0.3521-004 / 0.1696-004
0.	0.	19.4	3.2	29.0	19.4	6.5	19.4	3.2	0.				
0	1	4	1	6	12	5	2	0	0	ILB	AMPI	0.1380-006 / 0.1270-006	0.1337-006 / 0.8700-008
0.	3.2	12.9	3.2	19.4	38.7	16.1	6.5	0.	0.				
0	1	5	0	4	13	5	3	0	0	IL-12	AMPI	0.1240-006 / 0.1150-006	0.1200-006 / 0.8331-008
0.	3.2	16.1	0.	12.9	41.9	16.1	9.7	0.	0.				
0	0	7	0	6	7	8	3	0	0	IL-11	AMPI	0.1420-006 / 0.1330-006	0.1379-006 / 0.8672-008
0.	0.	22.6	0.	19.4	22.6	25.8	9.7	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4083	R518N	3078	GO	025 0	10C	XG	31

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	RARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	7	0	9	8	2	3	2	0	IC1C2	AMP	0.5400-007	0.4971-007
0.	0.	22.6	0.	29.0	25.8	6.5	9.7	6.5	0.			0.4700-007	0.1616-008
0	0	0	0	28	1	0	1	0	1	IC2C1	AMP	0.3710-006	0.6055-007
0.	0.	0.	0.	90.3	3.2	0.	3.2	0.	3.2			0.2900-007	0.5976-007
0	0	0	0	23	0	0	8	0	0	IC6GO	AMP	0.1423-004	0.3879-005
0.	0.	0.	0.	74.2	0.	0.	25.8	0.	0.			0.2400-007	0.5941-005
0	0	1	7	12	4	1	3	3	0	BTACI	AMP	0.5332-004	0.2023-004
0.	0.	3.2	22.6	38.7	12.9	3.2	9.7	9.7	0.			0.5489-005	0.1443-004
0	0	1	9	12	2	0	5	2	0	BTATI	AMP	0.5758-004	0.2518-004
0.	0.	3.2	29.0	38.7	6.5	0.	16.1	6.5	0.			0.9057-005	0.1421-004
0	0	0	7	15	3	2	3	0	1	IDSL	AMP	0.3501-004	0.6596-005
0.	0.	0.	22.6	48.4	9.7	6.5	9.7	0.	3.2			0.2600-006	0.9148-005
0	0	6	2	10	4	2	6	1	0	IDSH	AMP	0.7331-004	0.3399-004
0.	0.	19.4	6.5	32.3	12.9	6.5	19.4	3.2	0.			0.9090-005	0.1708-004
0	3	0	0	7	15	4	1	1	0	IL5	AMP	0.1240-006	0.1207-006
0.	9.7	0.	0.	22.6	48.4	12.9	3.2	3.2	0.			0.1170-006	0.1514-008
0	0	9	0	7	8	0	6	1	0	IL-12	AMP	0.1080-006	0.1045-006
0.	0.	29.0	0.	22.6	25.8	0.	19.4	3.2	0.			0.1020-006	0.1480-008
0	1	8	0	3	11	0	8	0	0	IL-11	AMP	0.1270-006	0.1249-006
0.	3.2	25.8	0.	9.7	35.5	0.	25.8	0.	0.			0.1210-006	0.1758-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
4053	R5180	7898	GO	825 G	406	XG	31

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	0	2	4	18	1	0	4	2	0	IC1G2	AMP	0.6000-007 / 0.5000-007	0.5513-007 / 0.2306-008
	0.	0.	6.5	12.9	58.1	3.2	0.	12.9	6.5	0.				
	0	0	6	2	8	0	12	3	0	0	IG2G1	AMP	0.5400-007 / 0.5000-007	0.5213-007 / 0.1284-008
	0.	0.	19.4	6.5	25.8	0.	38.7	9.7	0.	0.				
	0	0	0	0	24	0	0	7	0	0	IG6G0	AMP	0.1400-004 / 0.9400-007	0.3353-005 / 0.6056-005
	0.	0.	0.	0.	77.4	0.	0.	22.6	0.	0.				
	0	0	1	7	13	3	1	3	3	0	BTAGI	AMP	0.5343-004 / 0.5449-005	0.2016-004 / 0.1450-004
	0.	0.	3.2	22.6	41.9	9.7	3.2	9.7	9.7	0.				
	0	0	1	9	11	3	0	5	2	0	BTATI	AMP	0.5769-004 / 0.8980-005	0.2507-004 / 0.1428-004
	0.	0.	3.2	29.0	35.5	9.7	0.	16.1	6.5	0.				
	0	0	0	6	16	3	1	4	0	1	IBSL	AMP	0.3343-004 / 0.2100-006	0.6282-005 / 0.6676-005
	0.	0.	0.	19.4	51.6	9.7	3.2	12.9	0.	3.2				
	0	0	6	2	8	6	4	4	1	0	IBSH	AMP	0.7204-004 / 0.8400-005	0.3363-004 / 0.1711-004
	0.	0.	19.4	6.5	25.8	19.4	12.9	12.9	3.2	0.				
	0	3	3	0	6	14	2	3	0	0	IL5	AMP	0.1000-006 / 0.9200-007	0.1011-006 / 0.6452-008
	0.	9.7	9.7	0.	19.4	45.2	6.5	9.7	0.	0.				
	0	4	2	0	2	13	10	0	0	0	IL-12	AMP	0.9400-007 / 0.8000-007	0.8968-007 / 0.4643-008
	0.	12.9	6.5	0.	6.5	41.9	32.3	0.	0.	0.				
	0	2	5	1	3	8	10	2	0	0	IL-11	AMP	0.1120-006 / 0.9700-007	0.1065-006 / 0.4381-008
	0.	6.5	16.1	3.2	9.7	25.8	32.3	6.5	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R-518	D287	UGS	025 C	000	FE	23

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	0	0	21	1	0	0	0	1	IRQ09	AMP	0.5800-006	0.6952-007
0.	0.	0.	0.	91.3	4.3	0.	0.	0.	4.3			0.3900-007	0.1116-006
0	0	0	0	22	0	0	0	0	1	IBR04	AMP	0.1780-006	0.5291-007
0.	0.	0.	0.	95.7	0.	0.	0.	0.	4.3			0.4500-007	0.2729-007
1	0	0	0	7	13	2	0	0	0	IBR04	AMP	0.5000-007	0.4774-007
4.3	0.	0.	0.	30.4	56.5	8.7	0.	0.	0.			0.3800-007	0.2340-008
1	0	4	0	9	0	9	0	0	0	IRB02	AMP	0.4700-007	0.4609-007
4.3	0.	17.4	0.	39.1	0.	39.1	0.	0.	0.			0.4300-007	0.9960-009
0	0	2	8	0	10	0	3	0	0	IBB02	AMP	0.4900-007	0.4761-007
0.	0.	8.7	34.8	0.	43.5	0.	13.0	0.	0.			0.4600-007	0.8388-009
0	1	1	4	9	0	7	0	1	0	IBQ09	AMP	0.4900-007	0.4604-007
0.	4.3	4.3	17.4	39.1	0.	30.4	0.	4.3	0.			0.4300-007	0.1224-008
0	0	3	0	10	6	0	4	0	0	IRC01	AMP	0.4900-007	0.4735-007
0.	0.	13.0	0.	43.5	26.1	0.	17.4	0.	0.			0.4500-007	0.1191-008
	1			13	6		3			IDB 1	AMP	.49 - 7	.4743- 7
0.	4.3	0.	0.	56.5	26.1	0.	13.0	0.	0.			0.4500-007	0.8958-009
0	0	3	4	5	9	0	1	1	0	IDQ01	AMP	0.5100-007	0.4722-007
0.	0.	13.0	17.4	21.7	39.1	0.	4.3	4.3	0.			0.4500-007	0.1413-008
1	0	1	0	1	20	0	0	0	0	IDE01	AMP	0.4800-007	0.4487-007
4.3	0.	4.3	0.	4.3	87.0	0.	0.	0.	0.			0.2100-007	0.8849-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4093	R5180	1318	UGS	025 0	340	XG	21

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	6	1	4	7	0	2	1	0	IRQ09	AMP	0.4800-007 / 0.3900-007	0.4171-007 / 0.8513-008
0.	0.	28.6	4.8	19.0	33.3	0.	9.5	4.8	0.				
0	0	4	2	2	6	5	2	0	0	IQR04	AMP	0.5000-007 / 0.3800-007	0.4467-007 / 0.8411-008
0.	0.	19.0	9.5	9.5	28.6	23.8	9.5	0.	0.				
1	2			8	2	3	5			IQR04	AMP	.51 - 7 / 0.3900-007	.4671- 7 / 0.8288-008
0.	4.8	9.5	0.	38.1	9.5	14.3	23.8	0.	0.				
0	0	4	0	4	8	2	3	0	0	IRB02	AMP	0.5100-007 / 0.4000-007	0.4562-007 / 0.8619-008
0.	0.	19.0	0.	19.0	38.1	9.5	14.3	0.	0.				
0	2	1	1	4	9	2	1	1	0	IQB02	AMP	0.5200-007 / 0.4100-007	0.4670-007 / 0.8587-008
0.	9.5	4.8	4.8	19.0	42.9	9.5	4.8	4.8	0.				
0	1	2	1	7	6	0	4	0	0	IBQ09	AMP	0.5000-007 / 0.3900-007	0.4529-007 / 0.8610-008
0.	4.8	9.5	4.8	33.3	28.6	0.	19.0	0.	0.				
0	1	2	1	7	3	5	2	0	0	IRC01	AMP	0.5100-007 / 0.3900-007	0.4605-007 / 0.8765-008
0.	4.8	9.5	4.8	33.3	14.3	23.8	9.5	0.	0.				
0	0	4	1	2	8	2	4	0	0	IQB01	AMP	0.5100-007 / 0.3900-007	0.4586-007 / 0.8484-008
0.	0.	19.0	4.8	9.5	38.1	9.5	19.0	0.	0.				
0	0	3	3	3	6	1	3	0	0	IQQ01	AMP	0.5200-007 / 0.3900-007	0.4571-007 / 0.8538-008
0.	0.	14.3	14.3	23.8	28.6	4.8	14.3	0.	0.				
1	0	1	0	6	8	4	1	0	0	IQL01	AMP	0.5100-007 / 0.1600-007	0.4255-007 / 0.9466-008
4.8	0.	4.8	0.	28.6	38.1	19.0	4.8	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	2208	UGS	025 C	694	XG	21

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	1	4	0	6	4	0	6	0	0	IRG09	AMP	0.5700-007	0.5510-007
0.	4.8	19.0	0.	28.6	19.0	0.	28.6	0.	0.			0.5100-007	0.1758-008
0	1	2	3	5	6	0	4	0	0	IGR04	AMP	0.5900-007	0.5629-007
0.	4.8	9.5	14.3	23.8	28.6	0.	19.0	0.	0.			0.5300-007	0.1586-008
0	0	4	0	4	1	11	1	0	0	IBR04	AMP	0.6000-007	0.5795-007
0.	0.	19.0	0.	19.0	4.8	52.4	4.8	0.	0.			0.5500-007	0.1499-008
0	2	0	2	7	7	0	3	0	0	IRB02	AMP	0.5900-007	0.5629-007
0.	9.5	0.	9.5	33.3	33.3	0.	14.3	0.	0.			0.5300-007	0.1454-008
0	0	3	0	7	6	4	0	1	0	IGB02	AMP	0.6100-007	0.5757-007
0.	0.	14.3	0.	33.3	28.6	19.0	0.	4.8	0.			0.5500-007	0.1469-008
0	1	2	0	7	1	8	2	0	0	IBG09	AMP	0.5800-007	0.5590-007
0.	4.8	9.5	0.	33.3	4.8	38.1	9.5	0.	0.			0.5300-007	0.1411-008
0	0	3	3	4	5	3	3	0	0	IRC01	AMP	0.6000-007	0.5657-007
0.	0.	14.3	14.3	19.0	23.8	14.3	14.3	0.	0.			0.5400-007	0.1720-008
0	0	4	0	5	6	2	3	1	0	ICB01	AMP	0.6000-007	0.5686-007
0.	0.	19.0	0.	23.8	28.6	9.5	14.3	4.8	0.			0.5400-007	0.1558-008
0	0	3	0	6	10	0	2	0	0	ICG01	AMP	0.5900-007	0.5595-007
0.	0.	14.3	0.	28.6	47.6	0.	9.5	0.	0.			0.5300-007	0.1658-008
1	0	1	0	1	17	1	0	0	0	I E01	AMP	0.5900-007	0.5300-007
4.8	0.	4.8	0.	4.8	81.0	4.8	0.	0.	0.			0.2500-007	0.7457-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L40#3	R5180	3078	UQS	025 C	100	XG	21

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	BARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	0	2	7	5	4	0	1	2	0			
	0.	0.	9.5	33.3	23.8	19.0	0.	4.8	9.5	0.			
	0	0	5	0	0	11	0	5	0	0	IRQ09	AMP	0.5200-007 / 0.4600-007	0.4819-007 / 0.1721-008
	0.	0.	23.8	0.	0.	52.4	0.	23.8	0.	0.				
	0	0	5	0	0	11	0	5	0	0	IBR04	AMP	0.4800-007 / 0.4600-007	0.4700-007 / 0.7071-009
	0.	0.	23.8	0.	0.	52.4	0.	23.8	0.	0.				
	1	0	1	0	0	19	0	0	0	0	IBR04	AMP	0.5000-007 / 0.1700-007	0.4648-007 / 0.9125-008
	4.8	0.	4.8	0.	0.	90.5	0.	0.	0.	0.				
	0	2	0	0	9	4	5	1	0	0	IRB02	AMP	0.5000-007 / 0.4100-007	0.4729-007 / 0.2148-008
	0.	9.5	0.	0.	42.9	19.0	23.8	4.8	0.	0.				
	1	0	0	0	11	5	3	1	0	0	IBB02	AMP	0.5100-007 / 0.4100-007	0.4814-007 / 0.1982-008
	4.8	0.	0.	0.	52.4	23.8	14.3	4.8	0.	0.				
	0	1	1	6	0	5	8	0	0	0	IBQ09	AMP	0.5100-007 / 0.4700-007	0.4956-007 / 0.1153-008
	0.	4.8	4.8	28.6	0.	23.8	38.1	0.	0.	0.				
	0	1	1	1	12	0	5	1	0	0	IRC01	AMP	0.5300-007 / 0.4 00-007	0.5105-007 / 0.1071-00
	0.	4.	4.	4.	57.1	0.	23.	4.	0.	0.				
	0	0	8	0	0	6	0	7	0	0	ICB01	AMP	0.5300-007 / 0.5100-007	0.5195-007 / 0.4046-009
	0.	0.	38.1	0.	0.	28.6	0.	33.3	0.	0.				
	0	0	6	0	1	7	6	1	0	0	ICQ01	AMP	0.5300-007 / 0.4800-007	0.5071-007 / 0.1384-008
	0.	0.	28.6	0.	4.8	33.3	28.6	4.8	0.	0.				
	1	1	0	0	3	15	1	0	0	0	IDE01	AMP	0.5200-007 / 0.2300-007	0.4743-007 / 0.6690-008
	4.8	4.8	0.	0.	14.3	71.4	4.8	0.	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	7098	UGS	025 G	488	XG	21

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	4	0	2	12	0	3	0	0	IRG09	AMP	0.5100*007 / 0.4700*007	0.4948*007 / 0.1527*008
0.	0.	19.0	0.	9.5	57.1	0.	14.3	0.	0.				
0	1	0	3	6	5	5	1	0	0	IGR04	AMP	0.5400*007 / 0.4700*007	0.5152*007 / 0.1557*008
0.	4.8	0.	14.3	28.6	23.8	23.8	4.8	0.	0.				
0	1	2	0	0	16	0	1	1	0	IBR04	AMP	0.5500*007 / 0.5100*007	0.5295*007 / 0.7400*009
0.	4.8	9.5	0.	0.	76.2	0.	4.8	4.8	0.				
0	0	2	0	9	5	0	5	0	0	IRB02	AMP	0.5600*007 / 0.5200*007	0.5571*007 / 0.1146*008
0.	0.	9.5	0.	42.9	23.8	0.	23.8	0.	0.				
0	0	1	8	0	11	0	0	0	1	IGB02	AMP	0.6000*007 / 0.5300*007	0.5528*007 / 0.1521*008
0.	0.	4.8	38.1	0.	52.4	0.	0.	0.	4.8				
0	1	5	0	1	7	0	7	0	0	IBG09	AMP	0.5300*007 / 0.4900*007	0.5167*007 / 0.1517*008
0.	4.8	23.8	0.	4.8	33.3	0.	33.3	0.	0.				
0	0	3	0	13	2	0	1	2	0	IRG01	AMP	0.6000*007 / 0.5400*007	0.5629*007 / 0.1554*008
0.	0.	14.3	0.	61.9	9.5	0.	4.8	9.5	0.				
0	0	4	0	12	2	0	1	2	0	IBB01	AMP	0.6000*007 / 0.5400*007	0.5618*007 / 0.1670*008
0.	0.	19.0	0.	57.1	9.5	0.	4.8	9.5	0.				
0	0	3	5	0	4	9	0	0	0	IGG01	AMP	0.5600*007 / 0.5300*007	0.5498*007 / 0.1136*008
0.	0.	14.3	23.8	0.	19.0	42.9	0.	0.	0.				
1	0	1	0	2	17	0	0	0	0	IBE01	AMP	0.5600*007 / 0.2400*007	0.5218*007 / 0.7456*008
4.8	0.	4.8	0.	9.5	81.0	0.	0.	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L40B3	R-518	D287	UGS	025 C	000	FE	23

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	5	0	11	0	0	7	0	0			
0.	0.	21.7	0.	47.8	0.	0.	30.4	0.	0.	IEC0T	AMP	0.3300-007 / 0.3100-007	0.3209-007 / 0.9382-009
0	0	0	4	8	5	0	2	2	0			
0.	0.	0.	26.1	34.8	21.7	0.	8.7	8.7	0.	IEB0T	AMP	0.2010-006 / 0.4900-007	0.5874-007 / 0.4668-007
0	0	1	2	15	2	0	1	2	0			
0.	0.	4.3	8.7	65.2	8.7	0.	4.3	8.7	0.	BTATL	AMP	0.1078-003 / 0.6310-005	0.3535-004 / 0.2486-004
0	0	0	0	18	3	1	0	0	1			
0.	0.	0.	0.	78.3	13.0	4.3	0.	0.	4.3	BTATM	AMP	0.9646-002 / 0.3909-003	0.1895-002 / 0.1884-002
0	0	0	5	11	5	0	1	0	1			
0.	0.	0.	21.7	47.8	21.7	0.	4.3	0.	4.3	IC0C0	AMP	0.6000-007 / 0.4700-007	0.4917-007 / 0.8725-008
0	0	0	0	22	0	0	0	0	1			
0.	0.	0.	0.	95.7	0.	0.	0.	0.	4.3	IC0C0	AMP	0.5100-006 / 0.4700-007	0.6861-007 / 0.9797-007
0	0	9	0	0	9	0	5	0	0			
0.	0.	39.1	0.	0.	39.1	0.	21.7	0.	0.	IE0C0	AMP	0.3500-007 / 0.3300-007	0.3583-007 / 0.7777-009
0	0	0	7	7	6	0	2	0	1			
0.	0.	0.	30.4	30.4	26.1	0.	8.7	0.	4.3	IE0C0	AMP	0.1760-006 / 0.4700-007	0.7596-007 / 0.8723-007
0	0	0	2	13	5	0	1	1	1			
0.	0.	0.	8.7	56.5	21.7	0.	4.3	4.3	4.3	BTACL	AMP	0.1429-003 / 0.7630-005	0.3738-004 / 0.8088-004
0	0	1	3	12	3	1	1	2	0			
0.	0.	4.3	13.0	52.2	13.0	4.3	4.3	8.7	0.	BTACM	AMP	0.3071-002 / 0.4168-003	0.1335-002 / 0.7055-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4083	R5180	1318	UGS	025 0	340	XG	21

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	3	1	9	3	1	3	1	0	IECOT	AMPI	0.3600-007 / 0.3005-007
0.	0.	14.3	4.8	42.9	14.3	4.8	14.3	4.8	0.		0.2700-007	0.8334-008
0	0	0	4	9	4	0	2	2	0	IEBOT	AMPI	0.1970-006 / 0.6700-007
0.	0.	0.	19.0	42.9	19.0	0.	9.5	9.5	0.		0.5200-007	0.4789-007
0	0	1	2	13	2	0	1	2	0	BTATLI	AMPI	0.1247-003 / 0.3885-004
0.	0.	4.8	9.5	61.9	9.5	0.	4.8	9.5	0.		0.9340-005	0.8987-004
0	0	0	0	17	2	1	0	0	1	BTATMI	AMPI	0.9644-002 / 0.1606-002
0.	0.	0.	0.	81.0	9.5	4.8	0.	0.	4.8		0.3856-003	0.1941-002
0	1	2	3	6	1	7	0	1	0	IOBOC	AMPI	0.5900-007 / 0.4805-007
0.	4.8	9.5	14.3	28.6	4.8	33.3	0.	4.8	0.		0.3900-007	0.4341-008
0	0	0	0	20	0	0	0	0	1	IOEOC	AMPI	0.6270-006 / 0.7386-007
0.	0.	0.	0.	95.2	0.	0.	0.	0.	4.8		0.4100-007	0.1268-006
0	0	3	0	9	2	4	2	1	0	IECOB	AMPI	0.3600-007 / 0.3033-007
0.	0.	14.3	0.	42.9	9.5	19.0	9.5	4.8	0.		0.2700-007	0.8309-008
0	0	3	4	4	6	1	2	1	0	IEBOB	AMPI	0.1190-006 / 0.6814-007
0.	0.	14.3	19.0	19.0	28.6	4.8	9.5	4.8	0.		0.4100-007	0.1969-007
0	0	0	2	12	4	1	0	1	1	BTACLI	AMPI	0.1495-003 / 0.4174-004
0.	0.	0.	9.5	57.1	19.0	4.8	0.	4.8	4.8		0.8690-005	0.5363-004
0	0	1	3	11	2	1	1	2	0	BTACMI	AMPI	0.2958-002 / 0.1298-002
0.	0.	4.8	14.3	52.4	9.5	4.8	4.8	9.5	0.		0.4031-003	0.9049-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	2208	UGS	025 C	694	XG	21

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	0	0	11	0	9	0	0	0	1	IECOT	AMP	0.4300-007 / 0.4000-007	0.4057-007 / 0.7464-009
	0.	0.	0.	52.4	0.	42.9	0.	0.	0.	4.8			
	0	0	0	6	7	4	0	2	2	0	IEBOT	AMP	0.2060-006 / 0.5900-007	0.7729-007 / 0.4765-007
	0.	0.	0.	28.6	33.3	19.0	0.	9.5	9.5	0.			
	0	0	1	2	13	2	0	1	2	0	BTATLI	AMP	0.1068-003 / 0.6360-005	0.3830-004 / 0.2605-004
	0.	0.	4.8	9.5	61.9	9.5	0.	4.8	9.5	0.			
	0	0	0	0	17	2	1	0	0	1	BTATHI	AMP	0.9654-002 / 0.3857-005	0.1597-002 / 0.1945-002
	0.	0.	0.	0.	81.0	9.5	4.8	0.	0.	4.8			
	0	0	0	1	10	8	1	0	0	1	IDBOO	AMP	0.7100-007 / 0.5600-007	0.5875-007 / 0.2064-008
	0.	0.	0.	4.8	47.6	38.1	4.8	0.	0.	4.8			
	0	0	0	0	20	0	0	0	0	1	IDEOO	AMP	0.6360-006 / 0.4900-007	0.5471-007 / 0.1263-006
	0.	0.	0.	0.	95.2	0.	0.	0.	0.	4.8			
	0	0	1	6	7	0	5	2	0	0	IECOB	AMP	0.4400-007 / 0.4000-007	0.4205-007 / 0.1071-008
	0.	0.	4.8	28.6	33.3	0.	23.8	9.5	0.	0.			
	0	0	2	6	4	4	3	1	1	0	IEBOB	AMP	0.1290-006 / 0.5600-007	0.7843-007 / 0.1980-007
	0.	0.	9.5	28.6	19.0	19.0	14.3	4.8	4.8	0.			
	0	0	0	2	12	4	1	0	1	1	BTACLI	AMP	0.1280-003 / 0.7100-005	0.3525-004 / 0.2878-004
	0.	0.	0.	9.5	57.1	19.0	4.8	0.	4.8	4.8			
	0	0	1	3	11	2	1	1	2	0	BTACHI	AMP	0.2909-002 / 0.3972-003	0.1277-002 / 0.4934-003
	0.	0.	4.8	14.3	52.4	9.5	4.8	4.8	9.5	0.			

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	3078	UGS	025 C	10C	XG	21

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	NAME	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	3	0	2	0	15	0	1	0	0			
	0	14.3	0	9.5	0	71.4	0	4.8	0				
IEBOT											AMP	0.4100-007 / 0.3800-007	0.3967-007 / 0.9988-009
	0	0	0	4	9	4	0	2	2	0			
	0	0	0	19.0	42.9	19.0	0	9.5	9.5				
IEBOT											AMP	0.2040-006 / 0.5700-007	0.9486-007 / 0.4737-007
	0	0	1	1	14	2	0	1	2	0			
	0	0	4.8	4.8	66.7	9.5	0	4.8	9.5				
BTATLI											AMP	0.1556-003 / 0.1003-004	0.5056-004 / 0.5733-004
	0	0	0	0	17	2	1	0	0	1			
	0	0	0	0	81.0	9.5	4.8	0	0	4.8			
BTATW											AMP	0.9660-002 / 0.3931-003	0.1612-002 / 0.1943-002
	0	0	0	0	11	9	0	0	0	1			
	0	0	0	0	52.4	42.9	0	0	0	4.8			
IDBOG											AMP	0.6500-007 / 0.4900-007	0.5090-007 / 0.8477-008
	0	0	0	0	20	0	0	0	0	1			
	0	0	0	0	95.2	0	0	0	0	4.8			
IDEOG											AMP	0.6660-006 / 0.4500-007	0.7876-007 / 0.1346-006
	0	1	0	9	0	0	11	0	0	0			
	0	4.8	0	42.9	0	0	52.4	0	0				
IECOG											AMP	0.4100-007 / 0.3900-007	0.4046-007 / 0.4016-009
	0	0	3	5	4	4	2	2	1	0			
	0	0	14.3	23.8	19.0	19.0	9.5	9.5	4.8				
IEBOR											AMP	0.1250-006 / 0.5500-007	0.7743-007 / 0.2006-007
	0	0	1	2	11	4	1	0	1	1			
	0	0	4.8	9.5	52.4	19.0	4.8	0	4.8	4.8			
BTACLI											AMP	0.1755-003 / 0.1118-004	0.5263-004 / 0.5941-004
	0	0	1	3	11	2	1	1	2	0			
	0	0	4.8	14.3	52.4	9.5	4.8	4.8	9.5				
BTACW											AMP	0.2907-002 / 0.4037-003	0.1287-002 / 0.4880-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	7098	UGS	025 C	40C	XG	21

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	0	10	3	0	5	3	0	0	IEGOT	AMP	0.4000-007 / 0.3700-007	0.3805-007 / 0.1161-008
0.	0.	0.	47.6	14.3	0.	23.8	14.3	0.	0.				
0	0	0	4	10	3	0	2	2	0	IEBOT	AMP	0.2070-006 / 0.6000-007	0.9719-007 / 0.4888-007
0.	0.	0.	19.0	47.6	14.3	0.	9.5	9.5	0.				
0	0	1	2	12	3	0	1	2	0	BTATL	AMP	0.1309-003 / 0.8280-005	0.4098-004 / 0.3216-004
0.	0.	4.8	9.5	57.1	14.3	0.	4.8	9.5	0.				
0	0	0	0	17	2	1	0	0	1	BTATH	AMP	0.9696-002 / 0.4100-003	0.1633-002 / 0.1953-002
0.	0.	0.	0.	81.0	9.5	4.8	0.	0.	4.8				
0	0	0	0	17	1	1	1	0	1	ICBOG	AMP	0.7000-007 / 0.5400-007	0.5619-007 / 0.3572-008
0.	0.	0.	0.	81.0	4.8	4.8	4.8	0.	4.8				
0	0	0	0	20	0	0	0	0	1	ICEOG	AMP	0.6300-006 / 0.5000-007	0.8205-007 / 0.1269-006
0.	0.	0.	0.	95.2	0.	0.	0.	0.	4.8				
0	0	0	11	0	1	7	2	0	0	IEBOB	AMP	0.4300-007 / 0.4000-007	0.4109-007 / 0.1140-008
0.	0.	0.	52.4	0.	4.8	33.3	9.5	0.	0.				
0	0	1	7	4	5	1	2	1	0	IEBOB	AMP	0.1300-006 / 0.5700-007	0.8233-007 / 0.2241-007
0.	0.	4.8	33.3	19.0	23.8	4.8	9.5	4.8	0.				
0	0	1	2	11	5	0	0	1	1	BTAGL	AMP	0.9072-004 / 0.6380-005	0.2914-004 / 0.1959-004
0.	0.	4.8	9.5	52.4	23.8	0.	0.	4.8	4.8				
0	0	1	3	11	2	1	1	2	0	BTAGH	AMP	0.2528-002 / 0.3537-003	0.1139-002 / 0.5816-003
0.	0.	4.8	14.3	52.4	9.5	4.8	4.8	9.5	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R-518	D287	UGS	025 C	000	FE	25

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	BARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	5	0	11	0	4	2	1	0	IC1C2	AMP	0.5200-007	0.4748-007
0.	0.	21.7	0.	47.8	0.	17.4	8.7	4.3	0.			0.4500-007	0.1997-008
0	0	1	7	0	7	0	7	1	0	IC2C1	AMP	0.4800-007	0.4600-007
0.	0.	4.3	30.4	0.	30.4	0.	30.4	4.3	0.			0.4400-007	0.1000-008
0	0	0	0	22	0	0	0	0	1	IC6G8	AMP	0.1431-004	0.7459-006
0.	0.	0.	0.	95.7	0.	0.	0.	0.	4.3			0.4000-008	0.2959-005
0	0	2	2	10	6	0	1	2	0	BTACI	AMP	0.6016-004	0.1910-004
0.	0.	8.7	8.7	43.5	26.1	0.	4.3	8.7	0.			0.3845-005	0.1427-004
0	0	3	2	8	7	0	2	1	0	BTATI	AMP	0.6691-004	0.2396-004
0.	0.	13.0	8.7	34.8	30.4	0.	8.7	4.3	0.			0.4211-005	0.1518-004
0	0	0	10	5	1	4	1	2	0	IDSL	AMP	0.7286-004	0.2077-004
0.	0.	0.	43.5	21.7	4.3	17.4	4.3	8.7	0.			0.1160-005	0.2381-004
0	0	2	5	5	3	3	5	0	0	IDSH	AMP	0.9709-004	0.4804-006
0.	0.	8.7	21.7	21.7	13.0	13.0	21.7	0.	0.			0.1810-005	0.2806-004
0	0	2	3	7	8	0	2	1	0	IL5	AMP	0.1200-006	0.1158-006
0.	0.	8.7	13.0	30.4	34.8	0.	8.7	4.3	0.			0.1130-006	0.1833-008
0	0	3	3	11	2	1	2	1	0	IL-12	AMP	0.1080-006	0.1033-006
0.	0.	13.0	13.0	47.8	8.7	4.3	8.7	4.3	0.			0.1010-006	0.1849-008
0	0	2	4	6	7	1	2	1	0	IL-11	AMP	0.1250-006	0.1206-006
0.	0.	8.7	17.4	26.1	30.4	4.3	8.7	4.3	0.			0.1180-006	0.1727-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4083	RB180	1318	UQS	025 C	340	XQ	21

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	6	1	4	3	3	4	0	0	IDICE	AMP	0.5100-007 / 0.3700-007	0.4433-007 / 0.4768-008
0.	0.	28.6	4.8	19.0	14.3	14.3	19.0	0.	0.				
0	0	5	2	2	7	0	5	0	0	IDZCL	AMP	0.5000-007 / 0.3900-007	0.4443-007 / 0.5108-008
0.	0.	23.8	9.5	9.5	33.3	0.	23.8	0.	0.				
0	0	0	0	20	0	0	0	0	1	IDGGO	AMP	0.1429-004 / 0.	0.8026-006 / 0.8093-005
0.	0.	0.	0.	95.2	0.	0.	0.	0.	4.8				
0	0	1	3	10	4	0	1	2	0	BTACL	AMP	0.6054-004 / 0.3857-005	0.1930-004 / 0.1502-004
0.	0.	4.8	14.3	47.6	19.0	0.	4.8	9.5	0.				
0	0	3	2	7	6	0	2	1	0	BTATI	AMP	0.6736-004 / 0.4228-005	0.2435-004 / 0.1600-004
0.	0.	14.3	9.5	33.3	28.6	0.	9.5	4.8	0.				
0	0	0	8	7	1	2	1	2	0	IDSLI	AMP	0.7176-004 / 0.6500-006	0.1865-004 / 0.2348-004
0.	0.	0.	38.1	33.3	4.8	9.5	4.8	9.5	0.				
0	0	1	5	6	3	1	5	0	0	IDSW	AMP	0.9558-004 / 0.1290-005	0.4442-004 / 0.8637-004
0.	0.	4.8	23.8	28.6	14.3	4.8	23.8	0.	0.				
0	1	2	3	3	3	6	3	0	0	ILP	AMP	0.1180-006 / 0.1090-006	0.1143-006 / 0.2394-008
0.	4.8	9.5	14.3	14.3	14.3	28.6	14.3	0.	0.				
0	1	2	4	3	8	0	2	1	0	IL-1E	AMP	0.1070-006 / 0.9800-007	0.1026-006 / 0.2181-008
0.	4.8	9.5	19.0	14.3	38.1	0.	9.5	4.8	0.				
0	0	7	1	3	5	0	5	0	0	IL-11	AMP	0.1220-006 / 0.1140-006	0.1180-006 / 0.2906-008
0.	0.	33.3	4.8	14.3	23.8	0.	23.8	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	2208	UGS	025 C	694	XG	21

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	4	0	7	5	2	3	0	0	ID1C2	AMP	0.6000-007 / 0.5200-007	0.5614-007 / 0.8104-008
0.	0.	19.0	0.	33.3	23.8	9.5	14.3	0.	0.				
0	0	4	1	6	4	0	6	0	0	ID2C1	AMP	0.5700-007 / 0.5300-007	0.5533-007 / 0.1461-008
0.	0.	19.0	4.8	28.6	19.0	0.	28.6	0.	0.				
0	0	0	0	20	0	0	0	0	1	IC6GD	AMP	0.1422-004 / 0.2100-007	0.8188-006 / 0.8073-005
0.	0.	0.	0.	95.2	0.	0.	0.	0.	4.8				
0	0	1	3	10	4	0	1	2	0	BTACK	AMP	0.6047-004 / 0.3840-005	0.1922-004 / 0.1498-004
0.	0.	4.8	14.3	47.6	19.0	0.	4.8	9.5	0.				
0	0	3	2	7	6	0	2	1	0	BTATI	AMP	0.6726-004 / 0.4206-005	0.2426-004 / 0.1597-004
0.	0.	14.3	9.5	33.3	28.6	0.	9.5	4.8	0.				
0	0	0	9	5	1	3	1	2	0	IDSL	AMP	0.7204-004 / 0.1160-005	0.2045-004 / 0.8398-004
0.	0.	0.	42.9	23.8	4.8	14.3	4.8	9.5	0.				
0	0	2	4	5	3	2	5	0	0	IDSH	AMP	0.9564-004 / 0.1830-005	0.4746-004 / 0.2708-004
0.	0.	9.5	19.0	23.8	14.3	9.5	23.8	0.	0.				
0	0	8	0	4	0	6	3	0	0	ILD	AMP	0.1360-006 / 0.1330-006	0.1342-006 / 0.1123-008
0.	0.	38.1	0.	19.0	0.	28.6	14.3	0.	0.				
0	2	2	0	2	8	5	2	0	0	IL-LN	AMP	0.1240-006 / 0.1170-006	0.1208-006 / 0.7721-008
0.	9.5	9.5	0.	9.5	38.1	23.8	9.5	0.	0.				
0	0	6	0	5	7	0	3	0	0	IL-11	AMP	0.1420-006 / 0.1370-006	0.1390-006 / 0.1564-008
0.	0.	28.6	0.	23.8	33.3	0.	14.3	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4083	M5160	3078	UGS	025 C	100	XG	21

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	1	0	4	2	6	3	2	1	0			
0	4.8	0	28.6	9.5	28.6	14.3	9.5	4.8	0	IC1C2	AMP	0.5500-007 / 0.4700-007	0.5067-007 / 0.2824-008
0	0	6	0	6	0	0	9	0	0	IC2CL	AMP	0.4900-007 / 0.4700-007	0.4814-007 / 0.8536-009
0	0	0	0	20	0	0	0	0	1	IC6GD	AMP	0.1423-004 / 0.3000-008	0.6052-008 / 0.5078-005
0	0	1	3	10	4	0	1	2	0	BTACE	AMP	0.6062-004 / 0.3877-005	0.1932-004 / 0.2498-004
0	0	3	2	7	6	0	2	1	0	BTATI	AMP	0.6749-004 / 0.4247-005	0.2441-004 / 0.1601-004
0	0	0	8	4	1	3	1	2	0	IDSL	AMP	0.7221-004 / 0.1160-005	0.2015-004 / 0.2403-004
0	0	3	3	9	3	2	5	0	0	IDSH	AMP	0.9623-004 / 0.1170-005	0.4704-004 / 0.2725-004
0	2	2	0	3	7	5	2	0	0	ILB	AMP	0.1250-006 / 0.1150-006	0.1204-006 / 0.2181-008
0	0	7	0	1	4	7	2	0	0	IL-LE	AMP	0.1070-006 / 0.1030-006	0.1048-006 / 0.1470-008
0	0	4	3	2	8	0	4	0	0	IL-11	AMP	0.1270-006 / 0.1220-006	0.1243-006 / 0.1592-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	7098	UGS	025 G	400	XG	21

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	0	1	1	13	3	0	0	3	0	IG1G2	AMP	0.6000-007 / 0.5419-007
	0.	0.	4.8	4.8	61.9	14.3	0.	0.	14.3	0.			0.4900-007 / 0.2768-008
	0	0	0	8	0	8	3	1	1	0	IG2G1	AMP	0.5600-007 / 0.5300-007
	0.	0.	0.	38.1	0.	38.1	14.3	4.8	4.8	0.			0.5200-007 / 0.1095-008
	0	0	0	0	20	0	0	0	0	1	IG6G0	AMP	0.1408-004 / 0.8026-006
	0.	0.	0.	0.	95.2	0.	0.	0.	0.	4.8			0.2900-007 / 0.3113-005
	0	0	1	3	10	4	0	1	2	0	BTAGI	AMP	0.6001-004 / 0.1923-004
	0.	0.	4.8	14.3	47.6	19.0	0.	4.8	9.5	0.			0.3914-005 / 0.1488-004
	0	0	3	2	7	6	0	2	1	0	BTATI	AMP	0.6700-004 / 0.2437-004
	0.	0.	14.3	9.5	33.3	28.6	0.	9.5	4.8	0.			0.4290-005 / 0.1598-004
	0	0	0	8	6	1	3	1	2	0	IDSL	AMP	0.7057-004 / 0.1949-004
	0.	0.	0.	38.1	28.6	4.8	14.3	4.8	9.5	0.			0.5200-006 / 0.2342-004
	0	0	2	4	5	3	2	5	0	0	IDSH	AMP	0.9400-004 / 0.4602-004
	0.	0.	9.5	19.0	23.8	14.3	9.5	23.8	0.	0.			0.1010-005 / 0.2706-004
	0	0	5	0	5	5	0	6	0	0	IL5	AMP	0.1070-006 / 0.1035-006
	0.	0.	23.8	0.	23.8	23.8	0.	28.6	0.	0.			0.1000-006 / 0.2316-008
	0	0	4	1	6	2	0	8	0	0	IL-12	AMP	0.9400-007 / 0.9243-007
	0.	0.	19.0	4.8	28.6	9.5	0.	38.1	0.	0.			0.9000-007 / 0.1535-008
	0	0	6	0	2	7	5	1	0	0	IL-11	AMP	0.1140-006 / 0.1091-006
	0.	0.	28.6	0.	9.5	33.3	23.8	4.8	0.	0.			0.1060-006 / 0.1957-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4083	R-518	D287	G5	025 C	ENV	PE	30

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	1	0	1	0	7	21	0	0	0	0	IRG09	AMP	0.4700-007 / 0.1300-007	0.4520-007 / 0.6419-008
	3.3	0.	3.3	0.	23.3	70.0	0.	0.	0.	0.				
	1	0	0	1	13	15	0	0	0	0	IGR04	AMP	0.4900-007 / 0.3100-007	0.4713-007 / 0.9277-008
	3.3	0.	0.	3.3	43.3	50.0	0.	0.	0.	0.				
	0	1	0	9	5	7	5	2	1	0	IBR04	AMP	0.5200-007 / 0.4400-007	0.4847-007 / 0.1655-008
	0.	3.3	0.	30.0	16.7	23.3	16.7	6.7	3.3	0.				
	0	2	4	0	2	20	0	2	0	0	IRB02	AMP	0.4800-007 / 0.4100-007	0.4897-007 / 0.2671-008
	0.	6.7	13.3	0.	6.7	66.7	0.	6.7	0.	0.				
	1	0	0	0	14	13	0	2	0	0	IGB02	AMP	0.5100-00 / 0.3600-007	0.4 43-00 / 0.8417-008
	3.3	0.	0.	0.	46.7	43.3	0.	6.7	0.	0.				
	1	1	0	0	11	15	2	0	0	0	IBG09	AMP	0.4800-007 / 0.3100-007	0.4547-007 / 0.5203-008
	3.3	3.3	0.	0.	36.7	50.0	6.7	0.	0.	0.				
	1	0	1	0	16	3	6	3	0	0	IRC01	AMP	0.5000-007 / 0.4300-007	0.4760-007 / 0.1476-008
	3.3	0.	3.3	0.	53.3	10.0	20.0	10.0	0.	0.				
	0	0	2	11	4	0	11	1	1	0	ICB01	AMP	0.5100-007 / 0.4600-007	0.4803-007 / 0.1217-008
	0.	0.	6.7	36.7	13.3	0.	36.7	3.3	3.3	0.				
	1	0	2	1	2	18	6	0	0	0	ICG01	AMP	0.4900-007 / 0.3900-007	0.4693-007 / 0.2067-008
	3.3	0.	6.7	3.3	6.7	60.0	20.0	0.	0.	0.				
	0	0	0	0	26	0	2	1	0	1	ICE01	AMP	0.6540-006 / 0.2200-007	0.5243-007 / 0.1207-006
	0.	0.	0.	0.	86.7	0.	6.7	3.3	0.	3.3				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R518N	1308	GS	025 C	340	XG	30

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	BARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	1	0	3	0	10	9	3	4	0	0	IRQ09	AMP	0.4800-007	0.4153-007
	3.3	0.	10.0	0.	33.3	30.0	10.0	15.3	0.	0.			0.2900-007	0.4100-008
	0	2	4	0	6	11	3	4	0	0	IBR04	AMP	0.5000-007	0.4483-007
	0.	6.7	13.3	0.	20.0	36.7	10.0	15.3	0.	0.			0.3900-007	0.2705-008
	0	2	1	0	15	6	0	6	0	0	IBR04	AMP	0.5100-007	0.4623-007
	0.	6.7	3.3	0.	50.0	20.0	0.	20.0	0.	0.			0.3900-007	0.2738-008
	0	0	6	0	6	10	1	6	1	0	IRB02	AMP	0.5100-007	0.4483-007
	0.	0.	20.0	0.	20.0	33.3	3.3	20.0	3.3	0.			0.3900-007	0.3052-008
	0	2	2	2	5	13	4	2	0	0	IGB02	AMP	0.5100-007	0.4597-007
	0.	6.7	6.7	6.7	16.7	43.3	13.3	6.7	0.	0.			0.3900-007	0.3157-008
	1	0	3	2	5	10	8	1	0	0	IBQ09	AMP	0.5100-007	0.4387-007
	3.3	0.	10.0	6.7	16.7	33.3	26.7	3.3	0.	0.			0.2900-007	0.4321-008
	0	0	7	1	7	4	5	6	0	0	IRC01	AMP	0.5100-007	0.4527-007
	0.	0.	23.3	3.3	23.3	13.3	16.7	20.0	0.	0.			0.3900-007	0.3513-008
	0	1	3	1	8	7	4	6	0	0	IDB01	AMP	0.5000-007	0.4567-007
	0.	3.3	10.0	3.3	26.7	23.3	13.3	20.0	0.	0.			0.3900-007	0.2987-008
	0	0	6	3	5	9	2	4	1	0	IDQ01	AMP	0.5100-007	0.4427-007
	0.	0.	20.0	10.0	16.7	30.0	6.7	15.3	3.3	0.			0.3900-007	0.3172-008
	0	0	0	0	26	0	2	1	0	1	IDE01	AMP	0.7160-006	0.6347-007
	0.	0.	0.	0.	86.7	0.	6.7	3.3	0.	3.3			0.3200-007	0.1336-006

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R518N	2208	GS	025 C	694	XG	30

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	1	0	0	0	13	15	0	0	0	1			
	3.3	0.	0.	0.	43.3	50.0	0.	0.	0.	3.3			
IRG09											AMP	0.7000-007	0.5457-007
												0.4100-007	0.4023-008
	1	0	0	0	8	21	0	0	0	0			
	3.3	0.	0.	0.	26.7	70.0	0.	0.	0.	0.			
IGR04											AMP	0.5800-007	0.5850-007
												0.2900-007	0.8131-008
	0	0	6	4	9	2	0	8	1	0			
	0.	0.	20.0	13.3	30.0	6.7	0.	26.7	3.3	0.			
IBR04											AMP	0.6100-007	0.5727-007
												0.5500-007	0.1721-008
	0	2	0	9	7	8	0	4	0	0			
	0.	6.7	0.	30.0	23.3	26.7	0.	13.3	0.	0.			
IRB02											AMP	0.5900-007	0.5613-007
												0.5300-007	0.1502-008
	0	0	2	10	4	9	0	3	2	0			
	0.	0.	6.7	33.3	13.3	30.0	0.	10.0	6.7	0.			
IGB02											AMP	0.6100-007	0.5823-007
												0.5600-007	0.1382-008
	1	0	0	2	12	9	6	0	0	0			
	3.3	0.	0.	6.7	40.0	30.0	20.0	0.	0.	0.			
IBG09											AMP	0.5800-007	0.5543-007
												0.4200-007	0.8944-008
	0	1	9	0	2	7	4	7	0	0			
	0.	3.3	30.0	0.	6.7	23.3	13.3	23.3	0.	0.			
IRG01											AMP	0.5900-007	0.5680-007
												0.5500-007	0.1710-008
	0	0	6	3	10	3	0	8	0	0			
	0.	0.	20.0	10.0	33.3	10.0	0.	26.7	0.	0.			
IBG01											AMP	0.6000-007	0.5713-007
												0.5400-007	0.1570-008
	0	1	4	4	4	6	5	6	0	0			
	0.	3.3	13.3	13.3	13.3	20.0	16.7	20.0	0.	0.			
IDG01											AMP	0.5900-007	0.5863-007
												0.5100-007	0.1956-008
	0	0	0	0	26	1	1	1	0	1			
	0.	0.	0.	0.	86.7	3.3	3.3	3.3	0.	3.3			
IDR01											AMP	0.7000-006	0.9160-007
												0.2100-007	0.1270-006

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4083	R518N	3078	05	025 C	100	XQ	30

-3STD	-2STD	-1STD	-+.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	NAME	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
1 / 3.3	0 / 0.	1 / 3.3	0 / 0.	12 / 40.0	13 / 43.3	1 / 3.3	2 / 6.7	0 / 0.	0 / 0.	IRG09	AMP	0.5400-007 / 0.3400-007	0.4810-007 / 0.8263-008
1 / 3.3	0 / 0.	0 / 0.	7 / 23.3	0 / 0.	11 / 36.7	9 / 30.0	2 / 6.7	0 / 0.	0 / 0.	IGR04	AMP	0.4900-007 / 0.4100-007	0.4700-007 / 0.1438-008
0 / 0.	1 / 3.3	9 / 30.0	0 / 0.	4 / 13.3	9 / 30.0	0 / 0.	7 / 23.3	0 / 0.	0 / 0.	IBR04	AMP	0.5100-007 / 0.4500-007	0.4840-007 / 0.1380-008
0 / 0.	2 / 6.7	0 / 0.	11 / 36.7	0 / 0.	3 / 10.0	12 / 40.0	2 / 6.7	0 / 0.	0 / 0.	IRB02	AMP	0.5000-007 / 0.4500-007	0.4797-007 / 0.1299-008
0 / 0.	0 / 0.	6 / 20.0	0 / 0.	14 / 46.7	5 / 16.7	0 / 0.	3 / 10.0	2 / 6.7	0 / 0.	IGB02	AMP	0.5300-007 / 0.4700-007	0.4933-007 / 0.1322-008
2 / 6.7	0 / 0.	0 / 0.	0 / 0.	10 / 33.3	16 / 53.3	2 / 6.7	0 / 0.	0 / 0.	0 / 0.	IBG09	AMP	0.5200-007 / 0.3500-007	0.4903-007 / 0.8792-008
0 / 0.	1 / 3.3	2 / 6.7	0 / 0.	12 / 40.0	10 / 33.3	0 / 0.	4 / 13.3	1 / 3.3	0 / 0.	IRC01	AMP	0.5400-007 / 0.4900-007	0.5157-007 / 0.1040-008
0 / 0.	0 / 0.	2 / 6.7	10 / 33.3	0 / 0.	6 / 20.0	0 / 0.	12 / 40.0	0 / 0.	0 / 0.	ICB01	AMP	0.5300-007 / 0.5000-007	0.5193-007 / 0.1015-008
1 / 3.3	0 / 0.	2 / 6.7	3 / 10.0	1 / 3.3	20 / 66.7	0 / 0.	3 / 10.0	0 / 0.	0 / 0.	ICG01	AMP	0.5300-007 / 0.4400-007	0.5077-007 / 0.1977-008
0 / 0.	0 / 0.	0 / 0.	0 / 0.	26 / 86.7	1 / 3.3	1 / 3.3	1 / 3.3	0 / 0.	1 / 3.3	ICE01	AMP	0.6970-008 / 0.3100-007	0.4760-007 / 0.1282-006

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	7098	GS	025 G	400	XG	30

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	1	0	0	2	9	12	6	0	0	0	IRG09	AMP	0.5100E-007 / 0.3700E-007	0.4907E-007 / 0.2586E-008
	3.3	0.	0.	6.7	30.0	40.0	20.0	0.	0.	0.				
	1	0	0	5	5	11	7	1	0	0	IGR04	AMP	0.5400E-007 / 0.4200E-007	0.5147E-007 / 0.2097E-008
	3.3	0.	0.	16.7	16.7	36.7	23.3	3.3	0.	0.				
	0	2	1	5	0	17	0	5	0	0	IBR04	AMP	0.5500E-007 / 0.5000E-007	0.5288E-007 / 0.1126E-008
	0.	6.7	3.3	16.7	0.	56.7	0.	16.7	0.	0.				
	0	1	2	0	12	10	0	5	0	0	IRB02	AMP	0.5600E-007 / 0.5000E-007	0.5359E-007 / 0.1406E-008
	0.	3.3	6.7	0.	40.0	33.3	0.	16.7	0.	0.				
	1	0	2	3	7	14	0	3	0	0	IGB02	AMP	0.6000E-007 / 0.4300E-007	0.5513E-007 / 0.3082E-008
	3.3	0.	6.7	10.0	23.3	46.7	0.	10.0	0.	0.				
	1	0	2	0	10	13	3	1	0	0	IBG09	AMP	0.5400E-007 / 0.4000E-007	0.5065E-007 / 0.2510E-008
	3.3	0.	6.7	0.	33.3	43.3	10.0	3.3	0.	0.				
	0	2	3	0	2	19	0	1	3	0	IRG01	AMP	0.6000E-007 / 0.5200E-007	0.5600E-007 / 0.1912E-008
	0.	6.7	10.0	0.	6.7	63.3	0.	3.3	10.0	0.				
	0	1	4	0	15	5	0	3	2	0	IGB01	AMP	0.6000E-007 / 0.5200E-007	0.5603E-007 / 0.1847E-008
	0.	3.3	13.3	0.	50.0	16.7	0.	10.0	6.7	0.				
	1	0	1	3	8	11	3	3	0	0	IGG01	AMP	0.6000E-007 / 0.4600E-007	0.5488E-007 / 0.2878E-008
	3.3	0.	3.3	10.0	26.7	36.7	10.0	10.0	0.	0.				
	0	0	0	0	25	1	1	1	0	1	IGE01	AMP	0.7070E-006 / 0.2700E-007	0.9208E-007 / 0.1305E-006
	0.	0.	0.	0.	86.7	3.3	3.3	3.3	0.	3.3				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R-518	D287	GS	025 C	ENV	FE	30

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	0	11	0	8	0	0	10	1	0	IECOT	AMP	0.3400-007 / 0.3100-007	0.3203-007 / 0.9299-009
	0.	0.	36.7	0.	26.7	0.	0.	33.3	3.3	0.				
	0	0	0	0	22	4	0	2	1	1	IEBOT	AMP	0.6350-006 / 0.4700-007	0.1270-006 / 0.1410-006
	0.	0.	0.	0.	73.3	13.3	0.	6.7	3.3	3.3				
	0	0	4	6	5	9	2	3	0	1	BTATL	AMP	0.6950-004 / 0.1162-004	0.2725-004 / 0.1389-004
	0.	0.	13.3	20.0	16.7	30.0	6.7	10.0	0.	3.3				
	0	0	1	9	10	3	2	3	2	0	BTATW	AMP	0.2483-002 / 0.5521-003	0.1171-002 / 0.8901-003
	0.	0.	3.3	30.0	33.3	10.0	6.7	10.0	6.7	0.				
	1	0	2	0	7	11	5	4	0	0	ICBOC	AMP	0.5100-007 / 0.4300-007	0.4887-007 / 0.2590-008
	3.3	0.	6.7	0.	23.3	36.7	16.7	13.3	0.	0.				
	0	0	0	0	27	1	0	1	0	1	ICECC	AMP	0.8640-006 / 0.5000-008	0.6760-007 / 0.2596-006
	0.	0.	0.	0.	90.0	3.3	0.	3.3	0.	3.3				
	0	0	0	14	0	9	0	6	1	0	IECOB	AMP	0.3600-007 / 0.3300-007	0.3550-007 / 0.8867-009
	0.	0.	0.	46.7	0.	30.0	0.	20.0	3.3	0.				
	0	0	0	0	23	3	0	2	1	1	IEBOB	AMP	0.5030-006 / 0.4500-007	0.1011-006 / 0.2013-006
	0.	0.	0.	0.	76.7	10.0	0.	6.7	3.3	3.3				
	0	0	4	3	12	5	2	2	2	0	BTACL	AMP	0.8043-004 / 0.8530-005	0.3806-004 / 0.1526-004
	0.	0.	13.3	10.0	40.0	16.7	6.7	6.7	6.7	0.				
	0	0	4	4	13	3	0	4	2	0	BTACW	AMP	0.2770-002 / 0.4621-003	0.1225-002 / 0.4385-003
	0.	0.	13.3	13.3	43.3	10.0	0.	13.3	6.7	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4093	R518N	1308	GS	025 C	340	XG	30

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	1	3	4	7	4	10	1	0	0	IECOT	AMP	0.3300-007 / 0.2500-007	0.3033-007 / 0.1863-008
0.	3.3	10.0	13.3	23.3	13.3	33.3	3.3	0.	0.				
0	0	0	0	22	4	0	2	1	1	IEBOT	AMP	0.6250-006 / 0.4500-007	0.1839-006 / 0.1395-006
0.	0.	0.	0.	73.3	13.3	0.	6.7	3.3	3.3				
0	0	4	6	6	8	2	2	1	1	BTATL	AMP	0.8055-004 / 0.1359-004	0.3150-004 / 0.1585-004
0.	0.	13.3	20.0	20.0	26.7	6.7	6.7	3.3	3.3				
0	0	1	9	10	3	2	3	2	0	BTATW	AMP	0.2475-002 / 0.5401-003	0.1159-002 / 0.8989-003
0.	0.	3.3	30.0	33.3	10.0	6.7	10.0	6.7	0.				
0	3	2	0	10	7	6	2	0	0	ICBOC	AMP	0.5200-007 / 0.3900-007	0.4620-007 / 0.8377-008
0.	10.0	6.7	0.	33.3	23.3	20.0	6.7	0.	0.				
0	0	0	0	27	1	0	1	0	1	ICEOC	AMP	0.6820-006 / 0.9000-008	0.6 03-007 / 0.7650-006
0.	0.	0.	0.	90.0	3.3	0.	3.3	0.	3.3				
0	2	4	0	9	9	0	6	0	0	ICCOB	AMP	0.3400-007 / 0.2700-007	0.3110-007 / 0.1867-008
0.	6.7	13.3	0.	30.0	30.0	0.	20.0	0.	0.				
0	0	0	0	23	3	0	2	1	1	ICEOB	AMP	0.4960-006 / 0.4100-007	0.7800-007 / 0.1017-006
0.	0.	0.	0.	76.7	10.0	0.	6.7	3.3	3.3				
0	0	4	3	12	5	2	2	2	0	BTACL	AMP	0.9018-004 / 0.1088-004	0.3958-004 / 0.2020-004
0.	0.	13.3	10.0	40.0	16.7	6.7	6.7	6.7	0.				
0	0	5	3	13	3	0	4	2	0	BTACW	AMP	0.2707-002 / 0.4633-003	0.1199-002 / 0.6255-003
0.	0.	16.7	10.0	43.3	10.0	0.	13.3	6.7	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4093	R518N	2208	GS	025 C	694	XG	30

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	2	0	15	0	11	0	2	0	IECOT	AMPI	0.4200-007 / 0.4043-007
0.	0.	6.7	0.	50.0	0.	36.7	0.	6.7	0.		0.3900-007	0.9279-009
0	0	0	0	22	4	0	2	1	1	IEBOT	AMPI	0.6370-006 / 0.1345-006
0.	0.	0.	0.	73.3	13.3	0.	6.7	3.3	3.3		0.5300-007	0.1398-006
0	0	4	6	5	9	2	2	1	1	BTATLI	AMPI	0.7017-004 / 0.2705-004
0.	0.	13.3	20.0	16.7	30.0	6.7	6.7	3.3	3.3		0.1156-004	0.1385-004
0	0	1	9	10	3	2	3	2	0	BTATW	AMPI	0.2459-002 / 0.1153-002
0.	0.	3.3	30.0	33.3	10.0	6.7	10.0	6.7	0.		0.5391-003	0.9961-003
0	0	4	0	12	6	6	0	2	0	ICBOC	AMPI	0.6100-007 / 0.5770-007
0.	0.	13.3	0.	40.0	20.0	20.0	0.	6.7	0.		0.5500-007	0.1368-006
0	0	0	0	27	1	0	1	0	1	ICLOC	AMPI	0.7820-006 / 0.9873-007
0.	0.	0.	0.	90.0	3.3	0.	3.3	0.	3.3		0.6000-008	0.1369-006
0	0	2	11	0	12	0	5	0	0	IECOB	AMPI	0.4300-007 / 0.4167-007
0.	0.	6.7	36.7	0.	40.0	0.	16.7	0.	0.		0.4000-007	0.8442-009
0	0	0	0	23	3	0	2	1	1	IEBOB	AMPI	0.5010-006 / 0.1072-006
0.	0.	0.	0.	76.7	10.0	0.	6.7	3.3	3.3		0.5200-007	0.1002-006
0	0	4	3	12	5	2	2	2	0	BTADLI	AMPI	0.7580-004 / 0.3030-004
0.	0.	13.3	10.0	40.0	16.7	6.7	6.7	6.7	0.		0.1011-004	0.1714-004
0	0	5	3	13	3	0	4	2	0	BTADW	AMPI	0.2669-002 / 0.1156-002
0.	0.	16.7	10.0	43.3	10.0	0.	13.3	6.7	0.		0.4857-003	0.4148-003

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4083	R518N	3078	GS	025 C	100	XG	30

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
1	1	0	4	0	22	0	2	0	0	IECOT	AMP	0.4100-007 / 0.3700-007	0.3977-007 / 0.7739-009
3.3	3.3	0.	13.3	0.	73.3	0.	6.7	0.	0.				
0	0	0	0	22	4	0	2	1	1	IEBOT	AMP	0.6320-006 / 0.5500-007	0.1520-006 / 0.1377-006
0.	0.	0.	0.	73.3	13.3	0.	6.7	3.3	3.3				
0	0	4	6	6	8	2	2	1	1	STATLI	AMP	0.1056-003 / 0.1837-004	0.4174-004 / 0.8095-004
0.	0.	13.3	20.0	20.0	26.7	6.7	6.7	3.3	3.3				
0	0	1	9	10	3	2	3	2	0	STATHI	AMP	0.2476-002 / 0.5529-003	0.1171-002 / 0.5973-003
0.	0.	3.3	30.0	33.3	10.0	6.7	10.0	6.7	0.				
0	1	4	0	6	9	7	3	0	0	ICBOC	AMP	0.5300-007 / 0.4800-007	0.5087-007 / 0.1306-008
0.	3.3	13.3	0.	20.0	30.0	23.3	10.0	0.	0.				
0	0	0	0	27	1	0	1	0	1	ICEOC	AMP	0.6600-006 / 0.1400-007	0.6770-007 / 0.1595-006
0.	0.	0.	0.	90.0	3.3	0.	3.3	0.	3.3				
0	1	0	12	0	0	17	0	0	0	IECOB	AMP	0.4100-007 / 0.3900-007	0.4053-007 / 0.8713-009
0.	3.3	0.	40.0	0.	0.	56.7	0.	0.	0.				
0	0	0	0	24	2	0	2	1	1	IEBOB	AMP	0.5070-006 / 0.5300-007	0.1060-006 / 0.1007-006
0.	0.	0.	0.	80.0	6.7	0.	6.7	3.3	3.3				
0	0	4	4	11	5	2	2	2	0	STACLI	AMP	0.1152-003 / 0.1597-004	0.4622-004 / 0.8539-004
0.	0.	13.3	13.3	36.7	16.7	6.7	6.7	6.7	0.				
0	0	6	2	13	3	0	4	2	0	STACHI	AMP	0.2677-002 / 0.4976-003	0.1200-002 / 0.6122-003
0.	0.	20.0	6.7	43.3	10.0	0.	13.3	6.7	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	7898	GS	025 C	400	XG	30

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	0	8	0	7	12	0	3	0	0	IEGST	AMP	0.4000-007 / 0.3700-007	0.3833-007 / 0.9942-009
0.	0.	26.7	0.	23.3	40.0	0.	10.0	0.	0.				
0	0	0	0	22	4	0	2	1	1	IEBST	AMP	0.6400-006 / 0.5400-007	0.1344-006 / 0.1402-006
0.	0.	0.	0.	73.3	13.3	0.	6.7	3.3	3.3				
0	0	4	6	7	8	1	2	1	1	BTATL	AMP	0.8801-004 / 0.1419-004	0.3321-004 / 0.1717-004
0.	0.	13.3	20.0	23.3	26.7	3.3	6.7	3.3	3.3				
0	0	1	9	9	4	2	3	2	0	BTATH	AMP	0.2595-002 / 0.5550-003	0.1187-002 / 0.6134-003
0.	0.	3.3	30.0	30.0	13.3	6.7	10.0	6.7	0.				
0	0	3	5	8	8	2	1	3	0	ICBOC	AMP	0.6000-007 / 0.5000-007	0.5483-007 / 0.2437-008
0.	0.	10.0	16.7	26.7	26.7	6.7	3.3	10.0	0.				
0	0	0	0	27	1	0	1	0	1	ICEOC	AMP	0.9030-006 / 0.7000-008	0.9353-007 / 0.1640-006
0.	0.	0.	0.	90.0	3.3	0.	3.3	0.	3.3				
0	0	0	0	20	3	0	6	1	0	IECOS	AMP	0.4300-007 / 0.4000-007	0.4060-007 / 0.9522-009
0.	0.	0.	0.	66.7	10.0	0.	20.0	3.3	0.				
0	0	0	0	23	3	0	2	1	1	ICBOS	AMP	0.5200-006 / 0.5400-007	0.1103-006 / 0.1045-006
0.	0.	0.	0.	76.7	10.0	0.	6.7	3.3	3.3				
0	0	4	4	13	4	0	3	2	0	BTASL	AMP	0.7034-004 / 0.8590-005	0.2677-004 / 0.1586-004
0.	0.	13.3	13.3	43.3	13.3	0.	10.0	6.7	0.				
0	0	5	3	12	4	0	4	2	0	BTASH	AMP	0.2437-002 / 0.4252-003	0.1074-002 / 0.5632-003
0.	0.	16.7	10.0	40.0	13.3	0.	13.3	6.7	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4093	R-918	D287	GS	025 C	ENV	FE	30

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
1 / 3.3	0 / 0.	2 / 6.7	2 / 6.7	11 / 36.7	11 / 36.7	0 / 0.	3 / 10.0	0 / 0.	0 / 0.	IC1C2	AMP	0.5200-007 / 0.3900-007	0.4730-007 / 0.8548-008
0 / 0.	0 / 0.	4 / 13.3	0 / 0.	10 / 33.3	13 / 43.3	0 / 0.	3 / 10.0	0 / 0.	0 / 0.	IC2C1	AMP	0.4800-007 / 0.4500-007	0.4650-007 / 0.8610-009
0 / 0.	0 / 0.	0 / 0.	0 / 0.	25 / 83.3	0 / 0.	0 / 0.	0 / 0.	5 / 16.7	0 / 0.	IC6GO	AMP	0.1431-004 / 0.1050-006	0.2476-005 / 0.8382-005
0 / 0.	0 / 0.	0 / 0.	7 / 23.3	12 / 40.0	6 / 20.0	0 / 0.	2 / 6.7	3 / 10.0	0 / 0.	BTACI	AMP	0.5238-004 / 0.4377-005	0.1892-004 / 0.1509-004
0 / 0.	0 / 0.	2 / 6.7	6 / 20.0	11 / 36.7	6 / 20.0	0 / 0.	2 / 6.7	3 / 10.0	0 / 0.	BTATI	AMP	0.5434-004 / 0.6108-005	0.2339-004 / 0.1446-004
0 / 0.	0 / 0.	0 / 0.	2 / 6.7	20 / 66.7	1 / 3.3	5 / 16.7	0 / 0.	0 / 0.	2 / 6.7	IDSLI	AMP	0.3703-004 / 0.7300-006	0.7007-005 / 0.8884-005
0 / 0.	0 / 0.	5 / 16.7	2 / 6.7	10 / 33.3	5 / 16.7	1 / 3.3	5 / 16.7	2 / 6.7	0 / 0.	IDSH	AMP	0.7329-004 / 0.6600-005	0.3806-004 / 0.1779-004
0 / 0.	2 / 6.7	2 / 6.7	1 / 3.3	9 / 30.0	4 / 13.3	12 / 40.0	0 / 0.	0 / 0.	0 / 0.	ILB	AMP	0.1170-006 / 0.1110-006	0.1155-006 / 0.1654-008
0 / 0.	0 / 0.	4 / 13.3	1 / 3.3	9 / 30.0	9 / 30.0	0 / 0.	7 / 23.3	0 / 0.	0 / 0.	IL-12	AMP	0.1070-006 / 0.1000-006	0.1039-006 / 0.1954-008
0 / 0.	1 / 3.3	3 / 10.0	0 / 0.	9 / 30.0	6 / 20.0	6 / 20.0	5 / 16.7	0 / 0.	0 / 0.	IL-11	AMP	0.1240-006 / 0.1170-006	0.1209-006 / 0.1583-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R518N	1308	GS	025	340	XG	30

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	0	0	2	9	4	5	2	7	1	0			
	0	0	6.7	30.0	13.3	16.7	6.7	23.3	3.3	0	IC1D2	AMP	0.5100-007 / 0.3600-007	0.4297-007 / 0.4004-008
	0	0	5	6	3	3	9	4	0	0			
	0	0	16.7	20.0	10.0	10.0	30.0	13.3	0	0	IC2CL	AMP	0.4900-007 / 0.3900-007	0.4563-007 / 0.3045-008
	0	0	0	0	25	0	0	0	5	0			
	0	0	0	0	83.3	0	0	0	16.7	0	IC6GD	AMP	0.1428-004 / 0.9800-007	0.2468-005 / 0.5373-005
	0	0	0	7	12	6	0	2	3	0			
	0	0	0	23.3	40.0	20.0	0	6.7	10.0	0	BTACE	AMP	0.5276-004 / 0.4402-005	0.1004-004 / 0.1521-004
	0	0	2	6	11	6	0	2	3	0			
	0	0	6.7	20.0	36.7	20.0	0	6.7	10.0	0	BTATE	AMP	0.5469-004 / 0.6152-005	0.2852-004 / 0.1498-004
	0	0	0	1	22	3	2	0	0	2			
	0	0	0	3.3	73.3	10.0	6.7	0	0	6.7	IDSL	AMP	0.3551-004 / 0.2800-006	0.6529-005 / 0.8530-005
	0	0	5	3	9	5	1	5	2	0			
	0	0	16.7	10.0	30.0	16.7	3.3	16.7	6.7	0	IDSH	AMP	0.7142-004 / 0.5830-005	0.3159-004 / 0.1748-004
	0	0	7	3	1	7	8	4	0	0			
	0	0	23.3	10.0	3.3	23.3	26.7	13.3	0	0	ILB	AMP	0.1180-006 / 0.1090-006	0.1140-006 / 0.8895-008
	0	0	9	0	1	11	4	4	1	0			
	0	0	30.0	0	3.3	36.7	13.3	13.3	3.3	0	IL-1R	AMP	0.1060-006 / 0.9700-007	0.1009-006 / 0.8406-008
	0	0	6	1	6	7	4	6	0	0			
	0	0	20.0	3.3	20.0	23.3	13.3	20.0	0	0	IL-11	AMP	0.1220-006 / 0.1110-006	0.1172-006 / 0.8579-008

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L2083	RS18N	2208	GS	025 C	694	XG	30

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	1	6	0	5	12	4	2	0	0	IC1C2	AMPI	0.5900-007 / 0.5200-007	0.5620-007 / 0.1827-008
0.	3.3	20.0	0.	16.7	40.0	13.3	6.7	0.	0.			
0	0	5	0	9	6	7	2	1	0	IC2C1	AMPI	0.5900-007 / 0.5300-007	0.5677-007 / 0.1455-008
0.	0.	16.7	0.	30.0	20.0	23.3	6.7	3.3	0.			
0	0	0	0	25	0	0	0	5	0	IC6GO	AMPI	0.1422-004 / 0.1260-006	0.2478-005 / 0.9341-005
0.	0.	0.	0.	83.3	0.	0.	0.	16.7	0.			
0	0	0	7	12	6	0	2	3	0	BTACI	AMPI	0.5266-004 / 0.4378-005	0.1897-006 / 0.1520-004
0.	0.	0.	23.3	40.0	20.0	0.	6.7	10.0	0.			
0	0	2	6	11	6	0	2	3	0	BTATI	AMPI	0.5463-004 / 0.6110-005	0.2545-004 / 0.1488-004
0.	0.	6.7	20.0	36.7	20.0	0.	6.7	10.0	0.			
0	0	0	2	21	1	4	0	0	2	IDSLI	AMPI	0.3774-004 / 0.5300-006	0.6780-005 / 0.9167-005
0.	0.	0.	6.7	70.0	3.3	13.3	0.	0.	6.7			
0	0	5	3	8	7	0	5	2	0	IDSH	AMPI	0.7285-004 / 0.6930-005	0.3836-006 / 0.1749-004
0.	0.	16.7	10.0	26.7	23.3	0.	16.7	6.7	0.			
0	1	4	4	2	11	4	4	0	0	ILP	AMPI	0.1380-006 / 0.1290-006	0.1345-006 / 0.2080-008
0.	3.3	13.3	13.3	6.7	36.7	13.3	13.3	0.	0.			
0	2	4	0	5	13	3	3	0	0	IL-12	AMPI	0.1240-006 / 0.1150-006	0.1203-006 / 0.2103-008
0.	6.7	13.3	0.	16.7	43.3	10.0	10.0	0.	0.			
0	1	4	1	2	16	5	1	0	0	IL-11	AMPI	0.1420-006 / 0.1330-006	0.1390-006 / 0.2133-008
0.	3.3	13.3	3.3	6.7	53.3	16.7	3.3	0.	0.			

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R518N	3078	GS	025 C	100	XG	30

-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	BARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
0	1	3	0	10	9	3	4	0	0	IC1D2	AMPI	0.5400-007 / 0.4400-007	0.5023-007 / 0.6144-008
0.	3.3	10.0	0.	33.3	30.0	10.0	13.3	0.	0.				
0	1	0	11	0	8	0	10	0	0	IC2C1	AMPI	0.5000-007 / 0.4500-007	0.4770-007 / 0.1062-008
0.	3.3	0.	36.7	0.	26.7	0.	33.3	0.	0.				
0	0	0	0	25	0	0	0	5	0	IC4BQ	AMPI	0.1423-004 / 0.1110-006	0.2467-005 / 0.5551-005
0.	0.	0.	0.	83.3	0.	0.	0.	16.7	0.				
0	0	0	7	12	6	0	2	3	0	STACI	AMPI	0.5285-004 / 0.4443-005	0.1011-004 / 0.1524-004
0.	0.	0.	23.3	40.0	20.0	0.	6.7	10.0	0.				
0	0	2	6	11	6	0	2	3	0	STATI	AMPI	0.5486-004 / 0.6180-005	0.2563-004 / 0.1460-004
0.	0.	6.7	20.0	36.7	20.0	0.	6.7	10.0	0.				
0	0	0	1	21	3	3	0	0	2	IDSLI	AMPI	0.3707-004 / 0.6500-006	0.5633-005 / 0.8782-005
0.	0.	0.	3.3	70.0	10.0	10.0	0.	0.	6.7				
0	0	5	3	9	5	2	4	2	0	IDSH	AMPI	0.7862-004 / 0.5870-005	0.3187-004 / 0.1759-004
0.	0.	16.7	10.0	30.0	16.7	6.7	13.3	6.7	0.				
0	3	0	3	0	16	5	3	0	0	ILP	AMPI	0.1830-004 / 0.1170-006	0.1809-004 / 0.1363-005
0.	10.0	0.	10.0	0.	53.3	16.7	10.0	0.	0.				
0	0	8	0	3	13	0	6	0	0	IL-LE	AMPI	0.1080-005 / 0.1020-006	0.1049-004 / 0.1506-005
0.	0.	26.7	0.	10.0	43.3	0.	20.0	0.	0.				
0	2	4	0	4	16	0	4	0	0	IL-LL	AMPI	0.1270-005 / 0.1210-006	0.1049-004 / 0.1659-005
0.	6.7	13.3	0.	13.3	53.3	0.	13.3	0.	0.				

FAMILY	TYPE	DATE	TEST NO.	TEMP	TIME	TEST	SET SIZE
L4053	R5180	7098	GS	025 G	40G	XG	30

	-3STD	-2STD	-1STD	-.67STD	MEAN	+.67STD	+1STD	+2STD	+3STD	PARA	UNIT	HIGH VALUE / LOW VALUE	MEAN / STD
	1	0	2	1	16	3	3	3	1	0	IG182	AMP	0.6000-007 / 0.4300-007	0.5330-007 / 0.3019-008
	3.3	0.	6.7	3.3	53.3	10.0	10.0	10.0	3.3	0.				
	0	0	6	0	10	10	0	4	0	0	IG281	AMP	0.5400-007 / 0.5000-007	0.5220-007 / 0.1202-008
	0.	0.	20.0	0.	33.3	33.3	0.	13.3	0.	0.				
	0	0	0	0	25	0	0	0	5	0	IG6GG	AMP	0.1400-004 / 0.9400-007	0.2480-005 / 0.5413-005
	0.	0.	0.	0.	83.3	0.	0.	0.	16.7	0.				
	0	0	0	7	12	6	0	2	3	0	BTAGI	AMP	0.5250-004 / 0.4370-005	0.1905-004 / 0.1526-004
	0.	0.	0.	23.3	40.0	20.0	0.	6.7	10.0	0.				
	0	0	2	6	11	6	0	2	3	0	BTATI	AMP	0.5456-004 / 0.6134-005	0.2353-004 / 0.1462-004
	0.	0.	6.7	20.0	36.7	20.0	0.	6.7	10.0	0.				
	0	0	0	2	21	3	2	0	0	2	IDSL	AMP	0.3464-004 / 0.1400-006	0.6319-005 / 0.8146-005
	0.	0.	0.	6.7	70.0	10.0	6.7	0.	0.	6.7				
	0	0	5	3	9	5	2	4	2	0	IDSH	AMP	0.7082-004 / 0.5680-005	0.3094-004 / 0.1739-004
	0.	0.	16.7	10.0	30.0	16.7	6.7	13.3	6.7	0.				
	0	0	5	0	7	12	4	2	0	0	IL5	AMP	0.1000-006 / 0.9600-007	0.1022-006 / 0.3217-008
	0.	0.	16.7	0.	23.3	40.0	13.3	6.7	0.	0.				
	0	2	3	0	3	14	5	3	0	0	IL-12	AMP	0.9600-007 / 0.8300-007	0.9153-007 / 0.3170-008
	0.	6.7	10.0	0.	10.0	46.7	16.7	10.0	0.	0.				
	0	3	2	0	2	11	11	1	0	0	IL-11	AMP	0.1110-006 / 0.1000-006	0.1076-006 / 0.3308-008
	0.	10.0	6.7	0.	6.7	36.7	36.7	3.3	0.	0.				

APPENDIX C

PROCESSING SPECIFICATIONS

PROCESSING SPECIFICATIONS

SUBJECT: VAPOR DEPOSITION OF SiO_2 BY THE OXIDATION OF SILANE

I. OBJECT

To describe the materials and procedures required for the vapor plating of SiO_2 for use on metalized integrated circuits.

II. EQUIPMENT

1. Plating System

   a. Sink hood or table with exhaust facility.

   b. Dry Oxygen - less than 10 ppm.

   c. Dry Nitrogen - less than 10 ppm.

   d. 3.5% ± 0.1% Silane in Nitrogen, Air Products Speciality Gas Dept., Emmaus, Pa., or equivalent.

   e. Flow Meters

      1. Oxygen - 0-350 cc/min. Air Calibration

      2. Nitrogen - 0-10000 cc/min. Air Calibration

      3. Nitrogen-Silane - 0-800 cc/min. Air Calibration

   f. Hot Plate

      1. Heating element - must heat to 500°C uniformly over a 6" diameter, 1" thick aluminum plate.

      2. Controller - must control to ± 1°C., Matheson Lab-Stat 0-500°C mercury thermometer, Matheson Co., or equivalent.

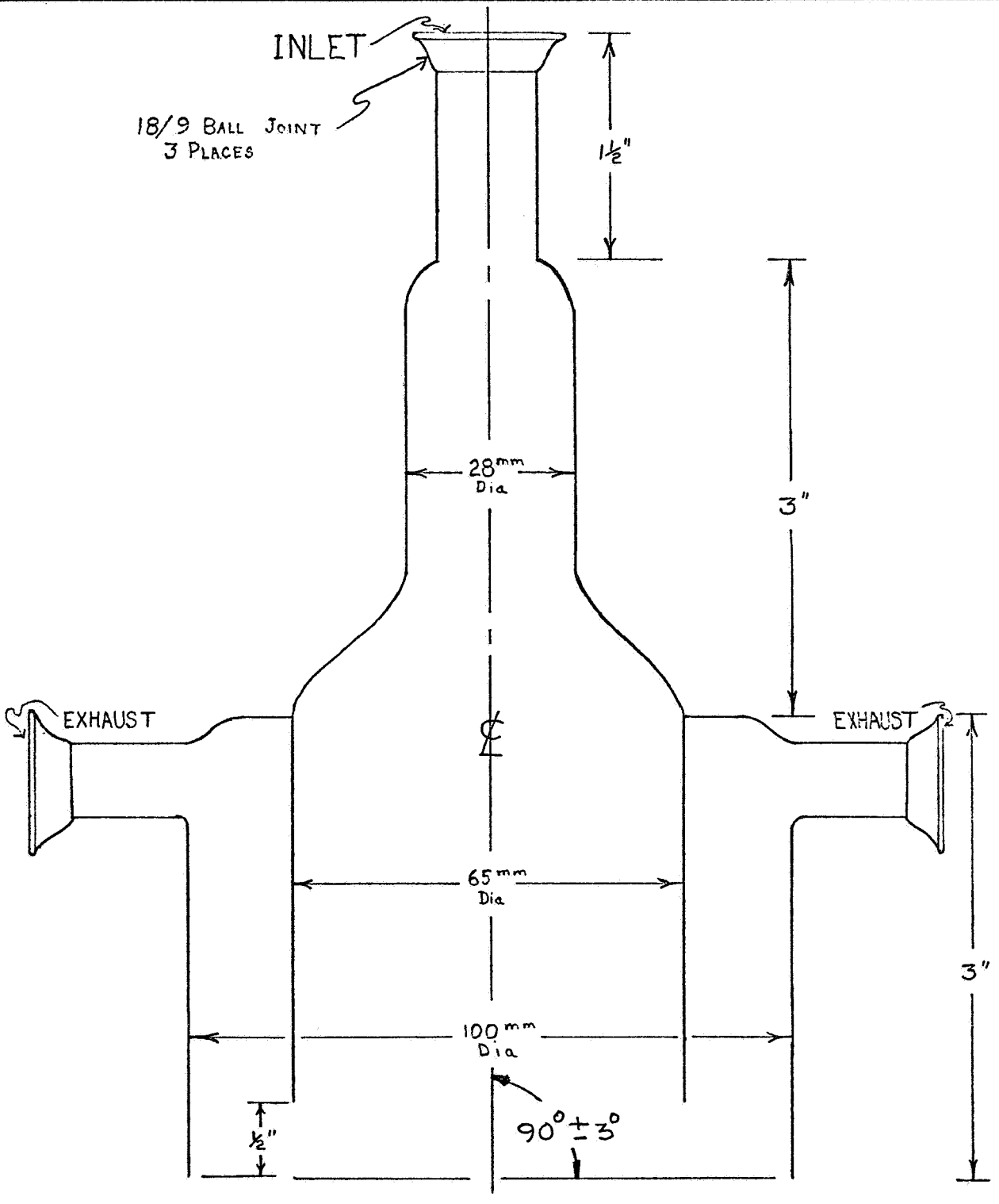
   g. Silane Tank Regulator and Safety Flush System, Air Products Corp., Emmaus, Pa.

   h. Lab Jack - to raise and lower hot plate.

   i. Plating Nozzles as per drawing Page 2 .

   j. Optional Equipment
      Optics Technology Monitor Photometer Model 240, C.E.Smith & Assoc. Summit, New Jersey

SUBJECT: VAPOR DEPOSITION OF SiO_2 BY THE OXIDATION OF SILANE



SUBJECT: VAPOR DEPOSITION OF SiO_2 BY THE OXIDATION OF SILANE

III. WAFER CLEANING EQUIPMENT

a. Sink and D.I. water

b. Methyl Alcohol Vapor Dryer

c. Trichloroethylene

d. Methyl Alcohol

IV. PROCEDURE

a. Start Up

1. Assemble equipment as per drawing Page 4. The hot plate and the flow meters should be located inside an exhaust hood.

2. Turn on Lab-Stat

3. Turn on power supply and control system. Allow hot plate to reach 400°C.

4. Flush SiH_4 line

(a) Open SiH_4 valve (1)

(b) Open N_2 Flush valve (2)

(c) Open regulator valve (3)

(d) Open outside exhaust valve (4)

Allow lines to flush for 2-3 minutes at regulator pressure of 5 psi.

(e) Close valves 4 - 3 - 2 1 in that order.

5. Set nitrogen flow meter (See addendum for conditions)

6. Set oxygen flow meter (See addendum for conditions)

7. Open SiH_4-N_2 tank valve (5). Set pressure regulator at 20 psi.

SUBJECT: VAPOR DEPOSITION OF SiO_2 BY THE OXIDATION OF SILANE

PROCEDURE (Continued)

8. Open regulator needle valve (3).

9. Open SiH_4 valve (1).

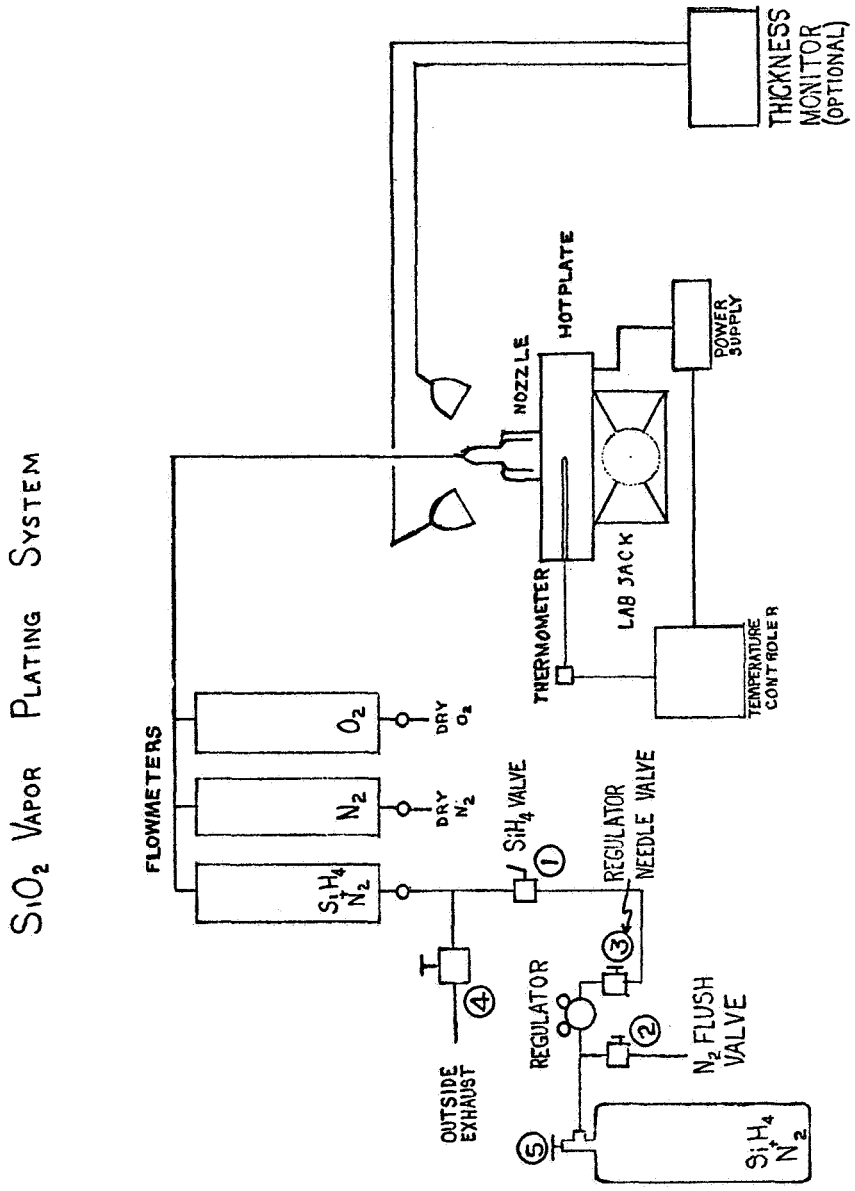
10. Set silane flow meter (See addendum for condition)

    Allow to run for approximately 1 minute.

11. Close SiH_4 valve (1)

    System is now ready for plating wafers.

SUBJECT: VAPOR DEPOSITION OF SiO_2 BY THE OXIDATION OF SILANE



SUBJECT: VAPOR DEPOSITION OF SiO_2 BY THE OXIDATION OF SILANE

PROCEDURE (Continued)

b. Wafer Cleaning

1. Spray with Trichloroethylene

2. Spray with Methanol

3. Dry in vapor dryer - if not dried immediately, store in Methanol until drying (not more than 15 minutes).

Note: Wafers should be glassed immediately after cleaning.

c. Vapor Plating

1. Place freshly cleaned wafer on hot plate, positioning so that it is in the center of the hot plate.

2. Raise hot plate until contact is made with the nozzle; positioning wafer directly under the inner section of the nozzle.

3. Open SiH_4 valve (1) and simultaneously turn on timer. Plating begins almost immediately.

4. Allow plating to continue for the desired time. (See addendum for time).

5. Close SiH_4 valve (1).

6. Lower hot plate and remove wafer.

7. Repeat Steps 1 through 6 for each successive wafer to be plated.

Note: After plating 10 wafers, the nozzle must be replaced with a clean nozzle.

d. Shut Down Procedure at End of Days Running:

1. Turn off Lab-Stat.

2. Turn off power supply and set variac to zero.

3. Shut off Silane flow meter.

4. Shut off oxygen flow meter.

SUBJECT: VAPOR DEPOSITION OF SiO_2 BY THE OXIDATION OF SILANE

PROCEDURE (Continued)

d. Shut Down Procedure at End of Days Running:

5. Set nitrogen flow meter to approximately 2000 cc/min.

6. Close SiH_4-N_2 tank valve (5).

7. Repeat Steps 4(a) thru 4(e) of Start Up Procedure. (Before completing Step 4(e), open Silane flow meter for 30 sec., close and proceed with final step 4(e).)

V. MONITORING OF VAPOR PLATING THICKNESS

1. Run one monitor before plating production wafers and one after completion of lot.

2. Strip one half of each monitor for thickness measurement. (Tally Surf or other)

3. Record reading in log book.

4. Return both monitors to lot.

5. The Optics Technology Monitor Photometer can be used as an alternative means of thickness control. Empirical calibration of this equipment is required for a particular angle of incidence between the wafer and light source; this angle (55°) is quite critical (±2°). The signal from the sensor is monitored by a strip chart recorder and has to be interpreted. The usefulness of this equipment is questionable on a fast production line and is intended to display the deposition process dynamically for engineering or set up purposes.

PROCESSING SPECIFICATIONS

ADDENDUM

DATE OF ISSUE

SUPERSEDES

SUBJECT: VAPOR DEPOSITION OF SiO_2 BY THE OXIDATION OF SILANE

ADDENDUM

For the laboratory system the flow conditions for a plating rate of 5000 Å/min. are:

Nitrogen	-	7000 cc/min	Flow Meters calibrated for air
Oxygen	-	300 cc/min	
Silane	-	600 cc/min	

These conditions used in a 2" diameter wafer will give a uniform SiO_2 layer (±500 Å) over 1.8" diameter of the wafer.

These flow rates may vary slightly from system to system and must be altered to control plating rate.