



CPG (CMPG)
Quality & Reliability Monitoring
Program

Quarterly Report
Ending September 2018

Microsemi's Commitment to You

We at Microsemi's Communication Medical Products Group (CPG (CMPG)) are committed to Customer Satisfaction through quality processes, products and service.

Product quality and reliability are built into every CMPG product from initial design to final packaging. When a product makes its way into production, ongoing quality and reliability monitoring programs are established, samples are taken from selected device families, process technologies, and finished package technologies. The Quality and Reliability Monitoring Program (RMP) Periodic Report will provide this information in which CMPG collects on a continual basis as qualification, production, and reliability monitors are completed.

Overview

This document pertains to Microsemi CPG part numbers that begin with a prefix of CLA, CLQ, CLT, DS, LE, MAX, MT, MVQ, MVT and ZL.

This document will be published quarterly with year-to-date data presented in a clear and concise manner. Data compiled will be shown and the proper mathematical adjustments will be made with the techniques shown within this report to deliver functional information. Results for each quarter will be shown as well as the cumulative, year-to-date results; the fourth quarter RMP report will culminate in a year-end report.

The Quality and Reliability Monitoring Program (RMP) Periodic Report will publish these results to our customers and stakeholders as an overview of our latest quality and reliability performance data. Our goal by providing these quarterly reports is to help our customers reduce and even eliminate special events for product validation through the utilization of the results communicated on a regular basis. Through this document, we aim to demonstrate CMPG's commitment to customer satisfaction, a quality product with a high degree of reliability, and provide the high level of confidence that our customers have come to expect from us.

Any failures are used to drive our Quality Organization forward to make all necessary corrections in our patented products, processes, and technologies. We hope you find this report helpful. Please let us know if you have any specific questions or suggestions of how we may serve you better.

This report will provide the following information:

- Average outgoing quality level – AOQL
- Estimates of shipped product quality
- Reliability monitoring results
 - High temperature operating estimates- Early and Extended life

- Failures in Time
 - Simulation of mounting on PCB- Preconditioning
 - Accelerated exposure to moisture- Autoclave

Quality Assurance Program

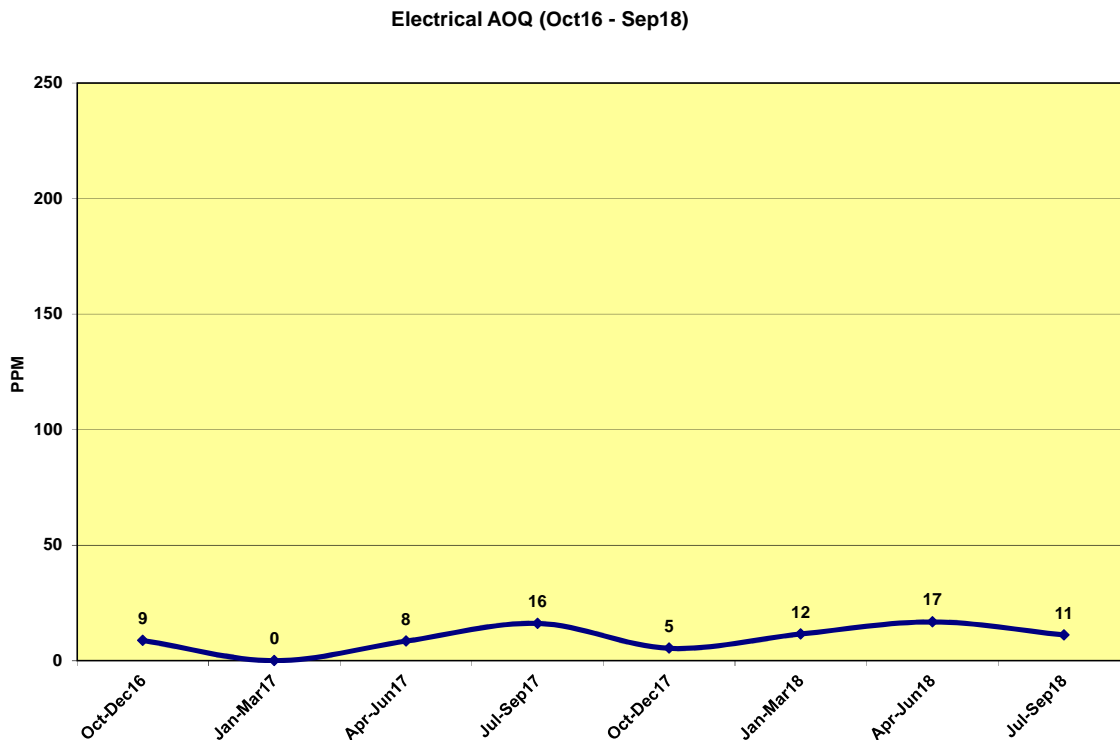
Quality is a set of attributes that characterize a device as good or bad, at time of delivery, regardless of meeting the manufacturer's or customers' specifications. The failures are generally expressed in Defects per million (DPM), Parts per million (PPM), or defective parts per million (DPPM).

Quality defects are generalized into two basic sets – Electrical and Visual/Mechanical. An Electrical failure is often most critical of the failure types and the most difficult to control. These types of failures are most likely found by stress aging.

Quality Assurance Data

The Calculated July 2018 to September 2018 AOQ per JEDEC JESD16-A is stated below:

Electrical AOQ = 11 ppm Visual Mechanical = 0 ppm (Not Shown)



Reliability Monitoring Program

Reliability is defined as a function over time in response to varied (specified) state condition. Reliability in this report is shown in Failure in time (FIT). One FIT represents “ONE FAILURE IN ONE BILLION DEVICE HOURS”.

The Reliability Monitoring Program (RMP) at CMPG is designed to provide a real-time continuous monitor of reliability performance of CMPG integrated circuits. This program encompasses a broad range of technologies and products, and furnishes failure rate data that can be used to evaluate long-term performance.

Where not covered by external subcontractor monitoring data, Device and Package monitoring activities are performed on package and wafer fab process types to maximize data usefulness to the end user. All testing is done according to the applicable methods of JESD659 and JESD47 to ensure conformance with generally accepted practices.

Reliability Monitor Test Methodology

The standard monitoring stresses, the major failure modes that they screen, and the critical device characteristics are shown in Table 1 below. Note that additional monitors may be added to, or substituted for the following, for some or all devices, based on actual failure mechanisms observed during the course of the monitoring program. Similarly, some monitors may be excluded based on historical data and subcontractor screening for certain technologies and technology families.

Table 1: Monitor, Failure Mode, and Critical Features

MONITOR	FAILURE MECHANISMS	CRITICAL DEVICE FEATURES
High Temperature Operating Life (JESD22-A108)	Ionic movement, time dependant dielectric breakdown (TDDB), electromigration, activation of latent defects, and general aging mechanisms.	Wafer manufacture family (fab, minimum feature size, starting material, processing steps). Worst case devices have large number of processing steps, high power dissipation, and high thermal resistance.
Moisture Preconditioning (SMD only) (J-STD-020)	Moisture sensitivity of surface mount devices.	Molding compound, package style. Worst case devices have large die.
Autoclave (JESD22-A102)	Chemical corrosions	Molding compound, package style and wafer back-end processing. Worst case devices have large die in small packages.
Temperature Cycling (JESD22-A104)	Fatigue stress, difference of thermal expansion coefficients (die to package, or in bonds).	Molding compound and wafer back end processing. Worst case devices have large die and small die to lead frame spacing.
High Temperature Storage (JESD22-A103)	Fatigue stress, Intermetallic Compound formation, aging mechanisms, oxidation.	Molding compound, package style and wafer back-end processing.
Unbiased HAST (JESD22-A118)	Chemical corrosions	Molding compound, package style and wafer back-end processing. Worst case devices have large die in small packages.

Testing by Process Technologies

When comparing process technologies, CMPG is primarily concerned with results from testing methods that look at a product's life cycle when exposed to High Temperature. High Temperature Operating Life (HTOL) is the stress test mainly used which adds high temperature and operating bias to the testing environment.

Testing by Packaging Technologies

When comparing packaging, CMPG is concerned with how well the package will hold up to extreme environmental conditions. Tests used include Preconditioning followed by Autoclave and Temperature Cycle as well as High Temperature Storage for some package types.

The RMP test samples are taken from production lots on a generic basis to represent CMPG's standard process flow for that given process or package technology. CMPG also uses the RMP data provided by our Wafer Fabrication Suppliers and Assembly Subcontractors to assure a reliable product.

Calculating Failure Rates

Reliability is often expressed as a percentage or the number of failures in a unit of time. In this RMP report, CMPG will express failure rate behavior as FIT or failures in one billion (10^9) device hours of operation. By applying an acceleration factor to show the effects of the experiment in more realistic terms, we can accurately apply the data into usable information so that corrective actions to improve upon our processes and products may be taken.

Accelerated Stress Testing

Since today's semiconductor devices are very reliable, failure-accelerating stress tests are needed to observe failure distributions within a reasonable time period. To interpret the results of accelerated stress testing, the accelerating effect of the stress must be well understood.

The relationship between stress and time to failure is determined by the activation energies of the dominant failure mechanisms for a given product. Activation energies have been determined from extensive stress testing. For times beyond the infant mortality period, an activation energy of 0.7eV is approximated for calculations within this report.

Failure Rate (FIT) and MTBF Calculations

Instantaneous failure rates rapidly decrease to a low, relatively constant level. Steady-state instantaneous failure rates are expressed in units of FITs, failures in one billion hours of operation. The FIT rate can be calculated from the equation:

$$FR = \frac{X_{(2C+2)}^2}{2NTAF} * 10^9 \text{ hours}$$

Where:

$X_{(2C+2)}$ = CHI-Square distribution factor with 2C+2 degrees of freedom (taken from chi-square tables)

C = Total number of failures

N = Total number of devices tested

T = Test duration for each device at the given conditions

AF = Acceleration Factor

$$MTBF = \frac{10^9}{FR}$$

The calculation of the failure rates and MTBF values at a given condition is accomplished through the determination of the accelerating factor (AF) for that condition. The Arrhenius equation is used for high temperature operating life data.

High Temperature Operating Life data is extrapolated to lower temperatures through the use of the Arrhenius equation (shown below) with an assumed activation energy.

It is standard to report results as failure rates at the 55 degrees C life test temperature and using the CHI-Square distribution factor associated with a 60% confidence level.

$$AF = \frac{FR_1}{FR_2} = e^{\frac{E_a (1/t_2 - 1/t_1)}{k}}$$

Where:

FR₁ = Failure Rate at Test Condition

FR₂ = Failure Rate at Use Condition

E_a = Activation Energy

t₁ = Test Temperature in Degrees Kelvin (=temperature in degrees Celsius + 273)

t₂ = Use Temperature in Degrees Kelvin (=temperature in degrees Celsius + 273)

k = Boltzmann's Constant (=0.86 X 10⁻⁴ eV/Kelvin)

e = 2.718

Standardized Stress Tests

RMP testing is conducted on products that are selected by process technology, assembly sites, and package types. Other criteria used to determine which devices are selected include strategic importance, production volume, process or product complexity, and devices that had recently undergone a corrective action.

Life Cycle Tests

High Temperature Operating Life (HTOL)

The purpose of High Temperature Operating Life (HTOL) is to simulate the end-user part application over early, inherent, or extended life period of the product, depending on the duration of the test. HTOL stresses components with high temperature while operating under higher than normal voltage. CMPG follows the JEDEC recommended test conditions at 125°C and run for up to 1000 hours, sometimes with periodic pulls at 168 and 500 hours to look for electrical failure. The elevated temperature and voltage are used to provide sufficient acceleration at a typical system ambient of 55°C (and assuming 60% confidence level and 0.7eV activation energy).

Early Life Failure Rate

An early life failure rate (ELFR) is the rate at which the device is expected to fail shortly after being put into service, typically within six months. An ELFR test of 168 hours is associated with test escapes, manufacturing defects, and marginal material. CMPG's target is $FIT \leq 350$.

Extended Life Failure Rate

The Extended Life Failure Rate looks for device failures after 1000 testing hours. This test shows the durability of a device for an extended operational life cycle. CMPG's target is $FIT < 100$.

Environmental Tests

Preconditioning

The purpose of the preconditioning (PC) test is to stress the packaging system of an integrated circuit by simulating the harsh environmental conditions that a device experiences when handled by customer during shipping, storage, circuit board assembly, and cleaning operations. The intent of the PC test is to identify a device's sensitivity to moisture-induced stress that can cause die surface delamination. CMPG

follows JEDEC Standard J-STD-020 for MSL3 that requires parts to be subjected to 125°C bake followed by moisture soak and three Pb-free temperatures reflow cycles for Pb-free products. Devices are then evaluated for visual defects and tested for changes within electrical specifications.

Failures in the packaging such as delamination, cracks and “popcorn” caused by expanding moisture inside may not be visible with naked eye. Delamination cracks and “popcorn” can cause short-term reliability failure even though the chip initially passes an electrical test. The scanning acoustic micrography (SAM) technique is used to monitor for these types of defects.

Autoclave

The purpose of the autoclave test is to evaluate the reliability of non-hermetic (plastic) and non-laminate (BGA) integrated circuits in humid conditions. The devices are subjected to excessive temperature and humidity while under elevated atmospheric pressure. JEDEC Standard JESD22-A102 specifies 121°C, 100% relative humidity, and 205kPa atmospheric pressure. These conditions induce accelerated penetration of moisture through the packaging or along its interface with the leads passing through it. Devices are then evaluated for visual defects and tested for changes within electrical specifications.

Temperature Cycle

The purpose of Temperature Cycle (TC) testing is to determine the reliability of the internal circuit, packaging structure, and their solder interconnects due to exposure to many cycles between alternating high and low temperature extremes. The TC test is intended to reveal any electrical and packaging deficiencies resulting from thermal expansion mismatch between the die and the package structure. CMPG follows the JEDEC Standard JESD22-A104 using condition B or C, for temperature cycle 1000 times, alternating between temperature extremes ranging from -55 °C to 125 °C or -65°C to 150°C respectively. These test conditions provide simulated results that compare to the extremes of storage and operation temperature to which the devices may be exposed. Devices are then evaluated for visual defects and tested for changes within electrical specifications.

High Temperature Storage

The purpose of High Temperature Storage (HTS) testing is to determine the effect on devices of long-term storage at elevated temperatures without any electrical stresses applied. CMPG follows the JEDEC Standard JESD22-A103 condition B (150°C) for 1000 hours. Devices are then evaluated for visual defects and tested for changes within electrical specifications.

Unbiased Highly Accelerated Stress Test

The purpose of the unbiased Highly Accelerated Stress Test (uHAST) is to evaluate the reliability of non-hermetic (plastic) and laminate (BGA) integrated circuits packages in non-condensing moisture or humid conditions. The devices are subjected to excessive temperature and humidity. JEDEC Standard JESD22-A118 specifies 130°C and 85% relative humidity. These conditions induce accelerated penetration of non-condensing moisture through the packaging or along its interface with the leads passing through it. Devices are then evaluated for visual defects and tested for changes within electrical specifications.

Solderability

The purpose of the testing is to examine the solderability of termination/external leads of the plastic packages. CMPG follows J-STD-002 to conduct this testing.

Tin Whisker Monitoring

Most studies agree that stress is a key catalyst for whisker growth. This includes:

- Stress in the electroplated deposit and substrate.

- Degree of whiskering is proportional to the amount of compressive stress available.

- Minimizing stress in both the deposit and substrate is an objective.

In the case of tin, whisker growth is believed to depend on a combination of the tin coating and the composition of the substrate. Compressive stress in the composite substrate and coating are considered the overriding cause of whisker growth. Internal and external compressive stresses are at the root of whisker growth. For these reasons CMPG is using a whisker mitigation procedure of annealing at 150 °C for 1 hour. The Tin Whisker Monitoring data is attached.

Life Cycle Testing (HTOL)
GLOBALFOUNDRIES

Technology HV7 (HV8) Bipolar						
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	0	3696	0	3192	0	2610
Cum FIT:	168Hrs ELFR:	19	500Hrs FIT:	7	1000Hrs FIT:	4
Technology HV4 Bipolar						
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	0	967	0	905	0	628
Cum FIT:	168Hrs ELFR:	72	500Hrs FIT:	26	1000Hrs FIT:	19
Technology BCD3T						
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	0	1759	0	1759	0	1227
Cum FIT:	168Hrs ELFR:	40	500Hrs FIT:	13	1000Hrs FIT:	10
Technology HV30 Bipolar						
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	0	726	0	726	0	583
Cum FIT:	168Hrs ELFR:	96	500Hrs FIT:	32	1000Hrs FIT:	20
Technology HV15 Bipolar						
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	0	1410	0	1410	0	1320
Cum FIT:	168Hrs ELFR:	50	500Hrs FIT:	17	1000Hrs FIT:	9
Technology 5/4/3um CMOS						
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	0	308	0	308	0	308
Cum FIT:	168Hrs ELFR:	227	500Hrs FIT:	76	1000Hrs FIT:	38
Technology 2/1.5um CMOS						
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	0	231	0	231	0	231
Cum FIT:	168Hrs ELFR:	303	500Hrs FIT:	102	1000Hrs FIT:	51

Technology		0.35um (0.32um) CMOS				
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	3	16266	0	9091	0	8844
Cum FIT:	168Hrs ELFR:	20	500Hrs FIT:	3	1000Hrs FIT:	1
Technology		0.18um CMOS				
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	5	11495	1	4250	0	4165
Cum FIT:	168Hrs ELFR:	42	500Hrs FIT:	12	1000Hrs FIT:	3
Technology		0.13um (0.11um) CMOS				
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	0	21691	0	11730	0	11421
Cum FIT:	168Hrs ELFR:	3	500Hrs FIT:	2	1000Hrs FIT:	1
Technology		0.055um LPE				
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	0	3237	0	3237	0	3237
Cum FIT:	168Hrs ELFR:	22	500Hrs FIT:	7	1000Hrs FIT:	4

TSMC

Technology		0.25um CMOS				
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	0	900	0	900	0	900
Cum FIT:	168Hrs ELFR:	78	500Hrs FIT:	26	1000Hrs FIT:	13
Technology		0.18um CMOS & RFCMOS				
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	1	6094	1	5705	0	5695
Cum FIT:	168Hrs ELFR:	25	500Hrs FIT:	9	1000Hrs FIT:	2
Technology		0.13um CMOS				
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	0	2811	0	2811	0	2811
Cum FIT:	168Hrs ELFR:	25	500Hrs FIT:	8	1000Hrs FIT:	4

HTOL
UMC

Technology		0.8um CMOS				
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	0	746	0	746	0	746
Cum FIT:	168Hrs ELFR:	94	500Hrs FIT:	31	1000Hrs FIT:	16

DALSA

Technology		1.5um (2.0um/3.0um/4.0um) CMOS				
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	0	546	0	546	0	546
Cum FIT:	168Hrs ELFR:	128	500Hrs FIT:	43	1000Hrs FIT:	22

GLOBALFOUNDRIES (formerly IBM)

Technology		0.5um SiGe				
	Total Sum of Valid Fails HTOL 168	Total Sum of Sample Size HTOL 168	Total Sum of Valid Fails HTOL 500	Total Sum of Sample Size HTOL 500	Total Sum of Valid Fails HTOL 1000	Total Sum of Sample Size HTOL 1000
Cum Sample Size:	0	625	0	625	0	625
Cum FIT:	168Hrs ELFR:	112	500Hrs FIT:	38	1000Hrs FIT:	19

Environmental Tests
ASE
Preconditioning MSL 3 (Pb-Free Reflow)

ASE Preconditioning MSL 3 Fails/Sample Size with Pb-Free Reflow					
	TQFP	LQFP	PLCC	QFN	LBGA
Oct-Dec 17	0/120	0/187	0/0	0/1620	0/120
Jan-Mar 18	0/0	0/0	0/0	0/609	0/278
Apr-Jun 18	0/0	0/0	0/0	0/1503	0/342
Jul-Sep 18	0/0	0/0	0/0	0/270	0/0
Total	0/120	0/187	0/0	0/4002	0/740

Temperature Cycling (1000 Cycles)

ASE Temp Cycle (1000 cycles) Fails/Sample Size Condition C (-65 C/150 C).					
	TQFP	LQFP	PLCC	QFN	LBGA
Oct-Dec 17	0/30	0/0	0/0	0/180	0/40
Jan-Mar 18	0/0	0/0	0/0	0/83	0/93
Apr-Jun 18	0/0	0/0	0/0	0/401	0/52
Jul-Sep 18	0/0	0/0	0/0	0/30	0/0
Total	0/30	0/0	0/0	0/694	0/185

High Temperature Storage (150C, 1000 Hours)

ASE High Temp Storage (HTS) Fails/Sample Size (150C, 1000 hours)					
	TQFP	LQFP	PLCC	QFN	LBGA
Oct-Dec 17	0/30	0/30	0/0	0/330	0/40
Jan-Mar 18	0/0	0/0	0/0	0/83	0/92
Apr-Jun 18	0/0	0/0	0/0	0/426	0/0
Jul-Sep 18	0/0	0/0	0/0	0/30	0/0
Total	0/30	0/30	0/0	0/869	0/132

Unbiased HAST (168 Hours)

ASE Unbiased-HAST (uHAST) Fails/Sample Size (168 hours)					
	TQFP	LQFP	PLCC	QFN	LBGA
Oct-Dec 17	0/29	0/0	0/0	0/30	0/40
Jan-Mar 18	0/0	0/0	0/0	0/30	0/93
Apr-Jun 18	0/0	0/0	0/0	0/55	0/52
Jul-Sep 18	0/0	0/0	0/0	0/30	0/0
Total	0/29	0/0	0/0	0/145	0/185

ASE
Autoclave (168 Hours)

ASE Autoclave (PCT) (168 hours)				
	Fails/Sample Size			
	TQFP	LQFP	PLCC	QFN
Oct-Dec 17	0/29	0/0	0/0	0/180
Jan-Mar 18	0/0	0/0	0/0	0/83
Apr-Jun 18	0/0	0/0	0/0	0/344
Jul-Sep 18	0/0	0/0	0/0	0/30
Total	0/29	0/0	0/0	0/637

PBGA

ASE PBGA				
	Fails/Sample Size			
	Preconditioning MSL 3 with Pb- Free Reflow	Temp Cycle (1000 cycles) Condition B (-55C to +125C)	High Temp Storage (HTS) 150C, 1000 hours	uHAST 130C, 85%RH, 96 hours
Oct-Dec 17	0/384	0/106	0/106	0/106
Jan-Mar 18	0/120	0/40	0/40	0/40
Apr-Jun 18	0/120	0/40	0/40	0/40
Jul-Sep 18	0/120	0/40	0/40	0/40
Total	0/744	0/226	0/226	0/226

Solderability

ASE Solderability				
	Fails/Sample Size			
	TQFP	LQFP	PLCC	QFN
Oct-Dec 17	0/280	0/640	0/400	0/650
Jan-Mar 18	0/185	0/130	0/130	0/240
Apr-Jun 18	0/540	0/720	0/320	0/625
Jul-Sep 18	0/170	0/710	0/280	0/520
Total	0/1175	0/2200	0/1130	0/2035

Tin Whisker Monitoring
ASE
Ambient, Temperature Humidity, Temperature Cycling Testing


PACKAGE	PRECON	AMBIENT (30 ±2 °C and 60 ±3% RH)	THT (55 ±3 °C and 85 ±3 % RH)	TCT (-55 +0/-10 °C to 85 +10/-0 °C)
		1500HRS	1500HRS	500CYC
PLCC 44L (C151)	No precon(A)	Total s/size: 6 units NO WHISKERS Inspection result: 0 / 264 leads PASS	Total s/size: 6 units NO WHISKERS Inspection result: 0 / 264 leads PASS	Total s/size: 6 units MAX LENGTH : 9.52µm Inspection result: 16/ 264 leads PASS
	SnPb reflow(C)	Total s/size: 6 units MAX LENGTH : 7.31µm Inspection result: 5/ 264 leads PASS	Total s/size: 6 units MAX LENGTH : 9.71µm Inspection result: 11/ 264 leads PASS	Total s/size: 6 units MAX LENGTH : 11.45µm Inspection result: 12/ 264 leads PASS
	Pb free reflow(D)	Total s/size: 6 units MAX LENGTH : 6.73µm Inspection result: 11/ 264 leads PASS	Total s/size: 6 units MAX LENGTH : 11.81µm Inspection result: 12/ 264 leads PASS	Total s/size: 6 units MAX LENGTH : 13.41µm Inspection result: 18/ 264 leads PASS
PLCC 44L (C194)	No precon(A)	Total s/size: 6 units MAX LENGTH : 7.42µm Inspection result: 6/ 264 leads PASS	Total s/size: 6 units NO WHISKERS Inspection result: 0 / 264 leads PASS	Total s/size: 6 units MAX LENGTH : 10.15µm Inspection result: 16/ 264 leads PASS
	SnPb reflow(C)	Total s/size: 6 units NO WHISKERS Inspection result: 0 / 264 leads PASS	Total s/size: 6 units MAX LENGTH : 9.58µm Inspection result: 10/ 264 leads PASS	Total s/size: 6 units MAX LENGTH : 8.95µm Inspection result: 13/ 264 leads PASS
	Pb free reflow(D)	Total s/size: 6 units MAX LENGTH : 9.62µm Inspection result: 8/ 264 leads PASS	Total s/size: 6 units MAX LENGTH : 10.41µm Inspection result: 15/ 264 leads PASS	Total s/size: 6 units MAX LENGTH : 12.43µm Inspection result: 18/ 264 leads PASS
LQFP 100L (C7025)	No precon(A)	Total s/size: 6 units NO WHISKERS Inspection result: 0 / 600 leads PASS	Total s/size: 6 units NO WHISKERS Inspection result: 0 / 600 leads PASS	Total s/size: 6 units MAX LENGTH : 6.71µm Inspection result: 5/ 600 leads PASS
	SnPb reflow(C)	Total s/size: 6 units NO WHISKERS Inspection result: 0 / 600 leads PASS	Total s/size: 6 units MAX LENGTH : 7.74µm Inspection result: 8/ 600 leads PASS	Total s/size: 6 units MAX LENGTH : 6.87µm Inspection result: 8/ 600 leads PASS
	Pb free reflow(D)	Total s/size: 6 units MAX LENGTH : 7.53µm Inspection result: 6/ 600 leads PASS	Total s/size: 6 units MAX LENGTH : 9.14µm Inspection result: 11/ 600 leads PASS	Total s/size: 6 units MAX LENGTH : 11.6µm Inspection result: 11/ 600 leads PASS

Note : MAXIMUM ALLOWABLE TIN WHISKER LENGTH / GROWTH BY REFERRING TO JEDEC STANDARD (JESD201).

- I) Temperature Cycling (TCT) : 45 µm
- II) Temperature / Humidity Storage (Ambient) : 20 µm
- III) High Temperature / Humidity Storage (THT) : 20 µm