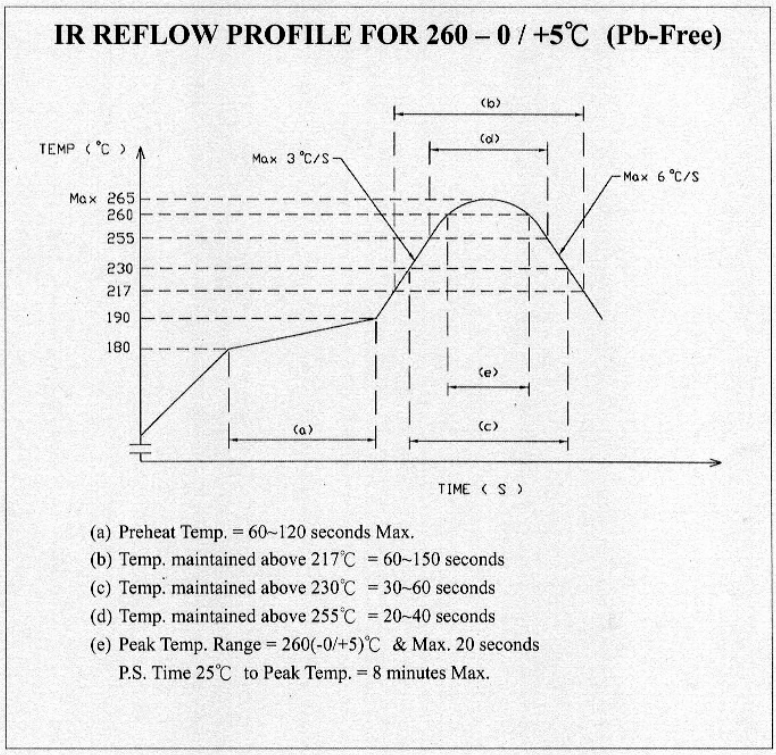
Test Item	Test Condition (Level III)	Test Time
Temp. Cycle	-65℃ ~ +150℃	5Cycles
Bake	125℃	24Hrs
Unbiased Temp-Humidity Soak	30℃, 60%R.H.	192Hrs
Convection Reflow		3Cycles

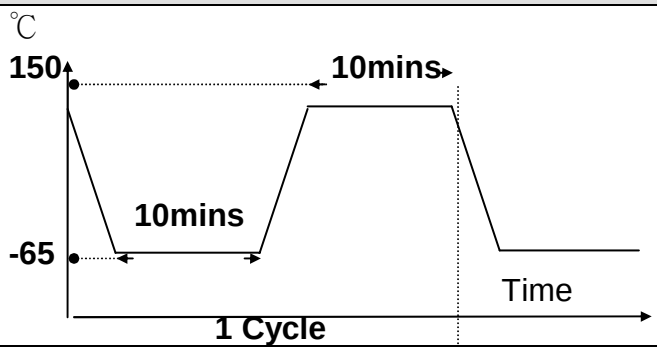
3.3.2.2. High-Temperature Storage Life Test

The high-temperature storage life test measures device resistance to a high-temperature environment that simulates a storage environment. The stress temperature is set to 150℃ in order to accelerate the effect of temperature on the test samples. In the test, no voltage bias is applied to the devices.

Test Item	Test Condition	Test Time
HTST	150℃	1000Hrs

3.3.2.3. Temperature Cycling Test

The purpose of temperature cycling test is to study the effect of thermal expansion mismatch among the different components within a specific die and package system. The cycling test system has a cold dwell at -65℃ and a hot dwell 150℃, and it employs a circulating air environment to ensure rapid stabilization at a specified temperature. During temperature cycling test, devices are inserted into the cycling test system and held at cold dwell for 10 minutes, then the devices are heated to hot dwell for 10 minutes. One cycle includes the duration at both extreme temperatures and the two transition times. The transition period is less than one minute at 25℃. Samples of surface mount devices must first undergo preconditioning and pass a final electrical test prior to the temperature cycling test.

Test Item	Test Condition	Test Time
TCT		500Cycles

3.3.2.4. Pressure Cooker Test

The pressure cooker test is an environmental test that measures device resistance to moisture penetration and the effect of galvanic corrosion. The stress conditions for the pressure cooker are 121℃, 100% relativity humidity, and 2.0atm pressure. Samples of surface mount devices are subjected to preconditioning and a final electrical test prior to the pressure cooker test.

Test Item	Test Condition	Test Time
PCT	121℃, 100%R.H., 2.0atm	96Hrs

3.3.2.5. Highly-Accelerated Temperature and Humidity Stress Test

The highly-accelerated temperature and humidity stress test is performed for the purpose of evaluating the reliability of nonhermetic packaged solid-state device in an environment with high humidity. It employs severe condition of temperature, humidity, and bias that accelerate the penetration of moisture through the external protective material (encapsulant or seal) or along the interface between the external protective material and the metallic conductor that pass through it. The stress conditions of the HAST are 130℃, 85% relativity humidity, 2.3atm pressure, and 1.575V maximum operating voltage. Samples of surface mount devices are subjected to preconditioning and a final electrical test prior to the highly-accelerated temperature and humidity stress test.

Test Item	Test Condition	Test Time
HAST	130℃, 85%R.H., 2.3atm, 1.575V	96Hrs

3.3.2.6. Steady State Temperature and Humidity Life Test

The temperature and humidity test is an environmental test designed to measure the corrosion and moisture resistance of plastic-encapsulated circuits. The stress conditions of the TH are 85℃ and 85% relativity humidity. Samples of surface mount devices are subjected to preconditioning and a final electrical test prior to the steady state temperature and humidity life test.

Test Item	Test Condition	Test Time
TH	85℃, 85%R.H.	1000Hrs

3.3.3. Test Criteria and Result

Table 4 shows the test results and reference standard of environmental test. The test status and results of AS4C64M16D3B-12BCN are also presented in the table. All pass from these test results mean that Alliance's SDRAM products are much more endurable in most of their service environment.

Test Item	Reference Standard	A/R Criteria	Failure/S.S.	Status	Failure Mode
Moisture Sensitivity	J-STD-020	0/1	0/304	PASS	N/A
HTST	JESD22-A103	0/1	0/76	PASS	N/A
TCT*	JESD22-A104	0/1	0/76	PASS	N/A
PCT*	JESD22-A102	0/1	0/76	PASS	N/A
HAST*	JESD22-A110	0/1	0/76	PASS	N/A
TH*	JESD22-A101	0/1	0/76	PASS	N/A

*** Sampling from Moisture Sensitivity**

Table 4. Environmental Test Criteria and Result

3.4. ESD Test

Electrical discharge into semiconductor product is one of the leading causes of device failure in the customer's manufacturing process. Alliance performs the ESD test to ensure that the performance of AS4C64M16D3B-12BCN will not be degraded to an unacceptable level by exposure to a succession of electrostatic discharge. The test methods and test results are shown in Table 5.

Test Item	Test Method				Result (F/S.S)
	Reference Standard	Test Condition	Criteria	Sample	
H.B.M.	JESD22-A114	R=1.5KΩ, C=100pF	≥±2KV	3ea	0/3
M.M.	JESD22-A115	R=0KΩ, C=200pF	≥±200V	3ea	0/3
C.D.M.	JESD22-C101	Non-Socket Mode	≥±1KV	3ea	0/3

Table 5. ESD Test Condition and Result

3.5. Latch-Up Test

CMOS products can be prone to over-voltage exceeding the maximum device rating if the parasitic p-n-p-n SCRs (Silicon-controlled rectifier) are improperly biased. When the SCR turns on, it draws excessive current and causes products being damaged by thermal runaway. The Table 6 shows the latch-up test method and the test result of no failure.

Test Item	Test Method			Result (F/S.S)
	Reference Standard	Test Condition & Criteria	Sample	
Latch-Up	JESD78	Vtr (+) ≧1.5 * Vcc Vtr (-) ≦-0.5 * Vcc Itr(+)≧100mA Itr(-)≦-100mA	6ea	0/6

Table 6. Latch-Up test Condition and Result

4. CONCLUSION

Reliability test is to ensure the ability of a product in order to perform a required function under specific conditions for a certain period of time. Through those tests, the devices of potential failure can be screened out before shipping to the customer. At the same time, the test results are fed back to process, design and other related departments for improving product quality and reliability.

According to the life time test data, *the short-term 12Hrs failure rate (= the normal operation 0-1 year) of AS4C64M16D3B-12BCN is equal to 0 DPM at Ta=55°C and Vcc=1.5V with 60% confidence level AND the long-term 1000Hrs failure rate (= the normal operation 1-10 year) of AS4C64M16D3B-12BCN is equal to 15 FIT at Ta=55°C and Vcc=1.5V with 60% confidence level.* The results of environmental test, ESD test and latch-up test also ensure that AS4C64M16D3B-12BCN is manufactured under a precise control of quality work by Alliance and its subcontractors. ***Thus, this experiment based on the Alliance reliability test standard for above test items can all pass***.

With the extensive research and development activities and the cooperation of all departments, Alliance continuously sets and maintains higher standard of quality and reliability to satisfy the future demand of its customers.