ABLIC

IC Quality Assurance System (Description)

Quality Assurance Solution Center
ABLIC Inc.

D-89-T223-001-Rev.16.0

Based on our quality policy, we work to achieve even higher levels of quality. In particular, we combine the low-power-consumption, low-voltage, high-precision, and ultra-compact package technologies developed through years of wristwatch development and manufacturing in our distinctive product development, and manufacture highly reliable, high-quality CMOS IC (Complementary Metal Oxide Semiconductor Integrated Circuit) products. In order to meet our customers' demanding quality requirements, we use our integrated, in-house system to handle everything from circuit design to manufacturing and sales. Through this, we engage in quality assurance activities that precisely meet our customers' demands.

Quality Policy

Basic Policy

We inspire and satisfy our customers with "Small, Smart, Simple" analog semiconductor products and solutions that make full use of our cutting-edge core technologies.

Activity Policy

1. We ensure conformance to the quality management system requirements, and implement continual improvements our quality management system using of process approach and risk-based thinking.
2. We comply with statutes and regulations, and provide conforming products to customer requirements.
3. We implement quality improvement activities to aim at zero field failures, and aim for the No.1 concerning the product quality of automotive components.

1. Quality Assurance System

In order to guarantee the level of quality required by customers, ABLIC Inc. reliably determines needs by reviewing product planning and design carries out thorough design reviews, and provides high-quality products to the marketplace by carrying out activities to ensure the highest possible quality in each in-house individual process at the manufacturing stage. A close relationship established among IC sections enables us to quickly respond to quality-related inquiries from customers. Figure 1 is the basic quality assurance system flow.

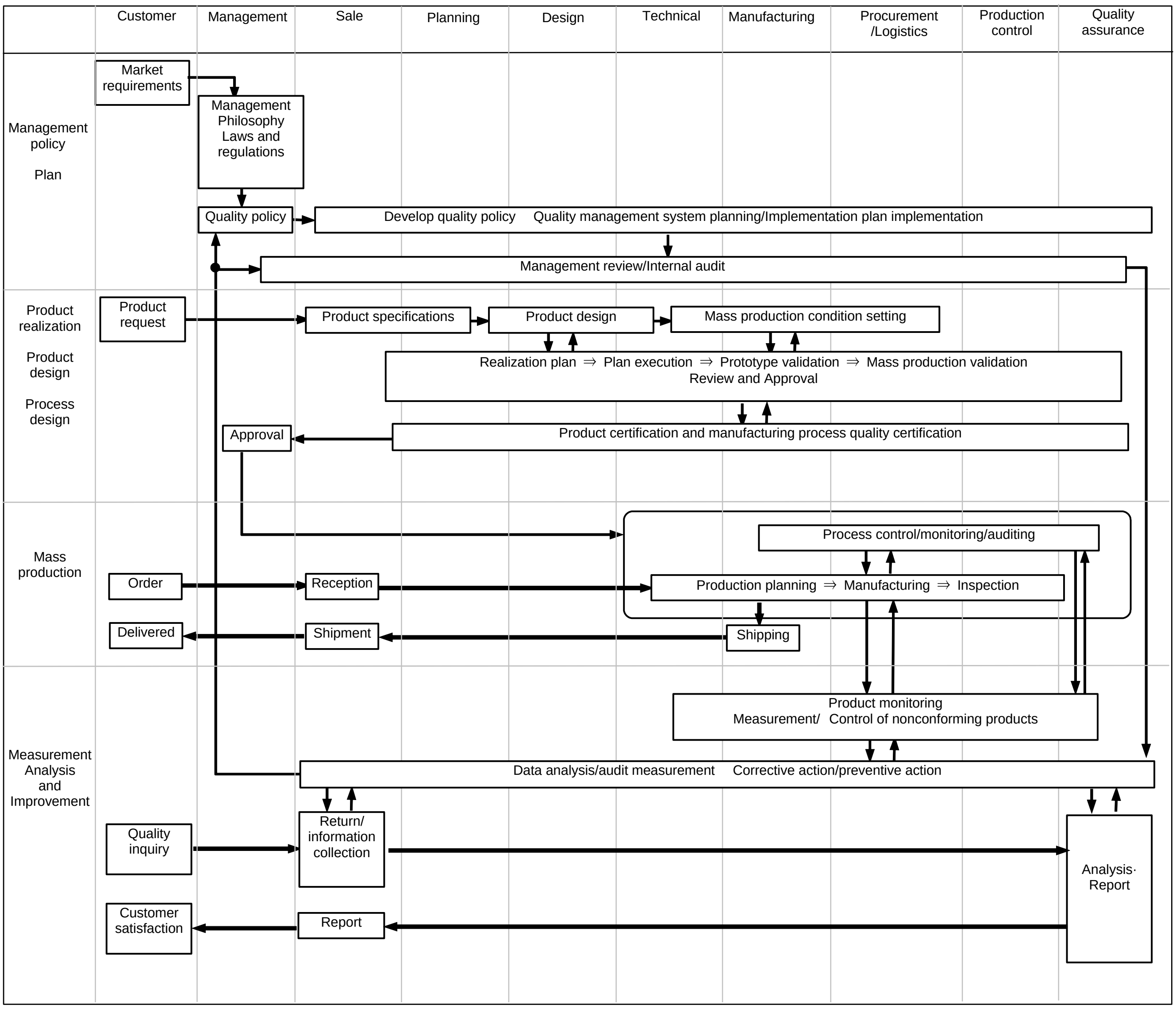


Figure 1 Basic quality assurance system flow.

2. Quality Assurance at the Development Stage

2. 1 Design Process

IC products are designed based on the market-oriented plan and using reliable design tools. Starting with basic functions, ABLIC Inc.'s design review committee examines engineering technology, quality data accumulated over the past years, use conditions, and use environment. The design and development of automotive products are carried out in accordance with AIAG APQP procedures. Figure 2 is the Basic quality assurance flow at the product development stage.

2. 2 Manufacturing process

Each individual IC manufacturing process is established based on the minute study of process flow, in-process, and final inspections to create the highest possible quality products.

2. 3 Quality qualification

IC products are inspected for their characteristics and reliability during the period from development to trial production to pre-mass production. Reliability tests conform to MIL-STD-883 and JEITA ED-4701. More strict testing terms and conditions may be added depending upon applications and environmental conditions, special requirements.

2. 4 Mass production decision

A multitude of factors, including the results of quality approval tests, problems arising during trial production tests, and customer engineering samples, are comprehensively studied. Mass production starts only when there is no problem.

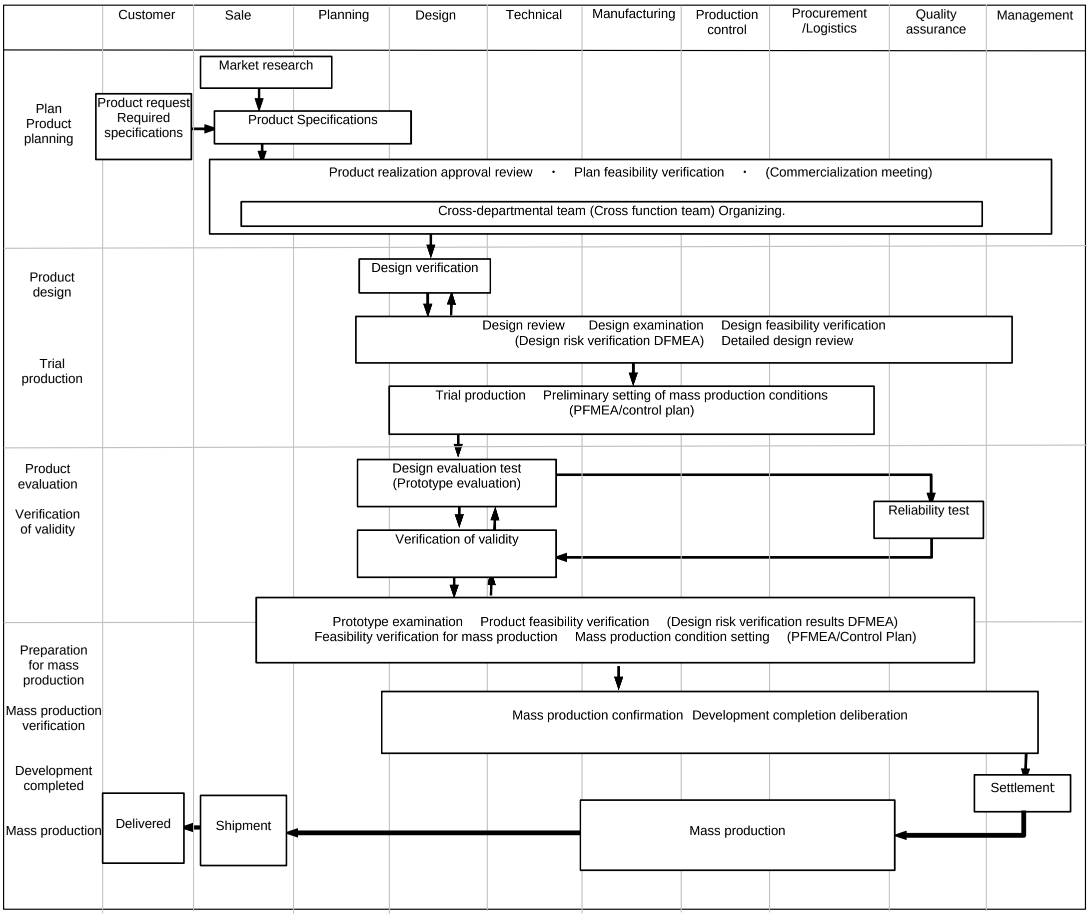


Figure 2 Basic quality assurance flow at the product development stage

3. Quality Assurance at the Mass Production Stage

To maintain the highest possible level of quality during mass production, ABLIC Inc.'s internal standards have been established. This enables us to ensure the quality of raw- and sub-materials and control each individual process, equipment, facility, and production environment. Figure 3 and Figure 4 is the Basic quality assurance flow at the mass production stage.

3. 1 Control of raw- and sub-materials

Raw- and sub-materials are purchased from manufacturers whose performance in business has been proven in accordance with the purchase specification created by ABLIC Inc. Once purchased, materials are subjected to appropriate quality tests based on ABLIC Inc.'s internal standards. If there is any change in purchasing routes, type or grade of materials, the respective quality assessment is exercised once again from the initial approval stage to make sure quality is maintained at the specified level.

3. 2 Control of facilities, measuring instruments, and production environment

The quality and reliability of IC products greatly depend upon the environmental facilities used in the manufacturing process. This means that only the optimum conditions ensure the highest possible quality and reliability. For this reason, specially appointed staff members at ABLIC Inc. are in charge of exercising preventive maintenance, regular inspections, and daily checks. This enables us to ensure stable manufacturing conditions and helps us better our manufacturing environment.

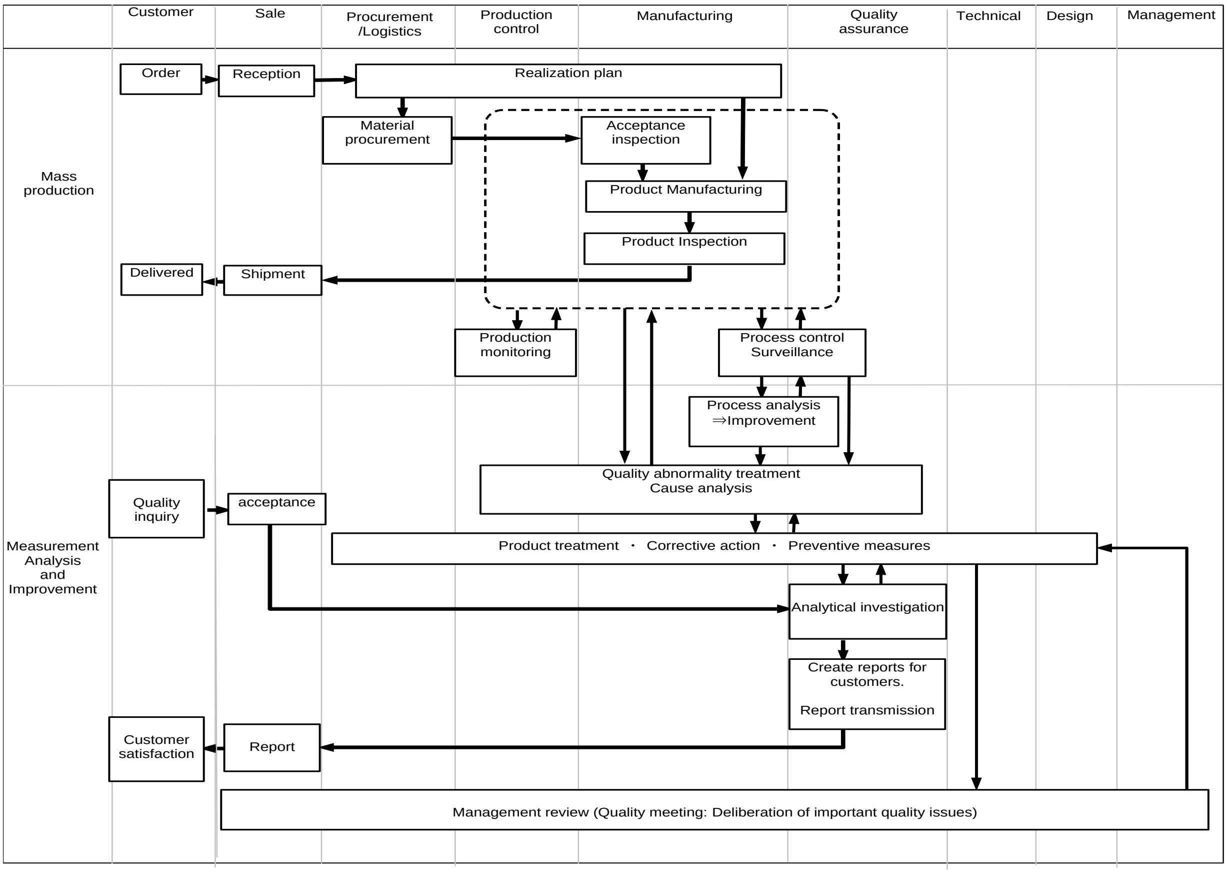


Figure 3 Basic quality assurance flow at the mass production stage.

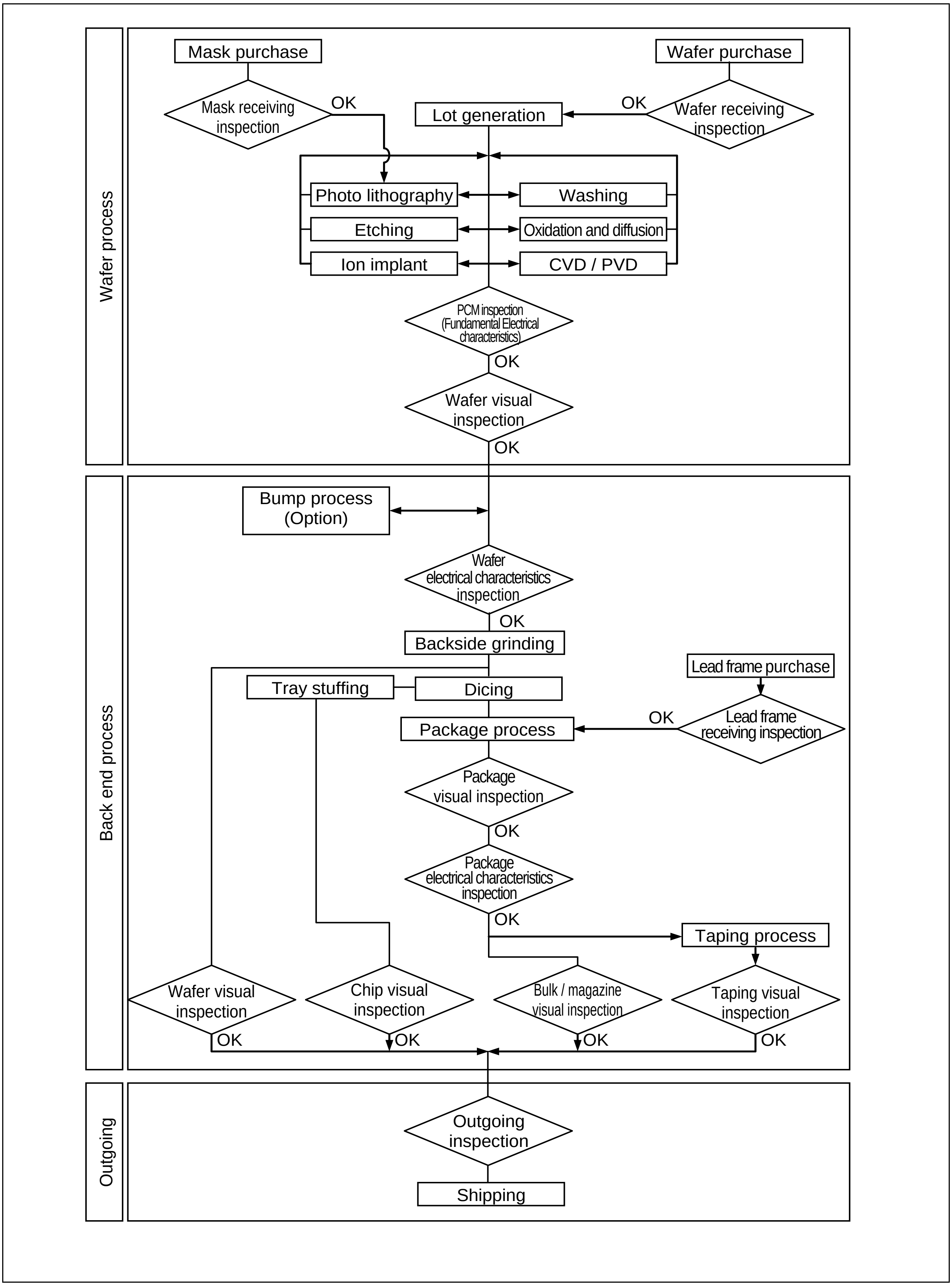


Figure 4 Quality Assurance System at the Mass Production Stage

3. 3 Process control

Carrying out work according to operation standards, QA point inspections according to quality assurance check sheets, and statistical control of data allows us to ensure the highest possible quality in each individual manufacturing process. Manufacturing process inspections are regularly exercised so that the quality level is maintained at all times. Quality-related information and data are forwarded to the preceding manufacturing process, this stabilizing the manufacturing process and improving quality.

3. 4 Modification control

Any and all modifications in design, process, facilities, equipment, raw- and sub-materials shall conform to ABLIC Inc.'s internal standards to prevent a quality problem. No modification in specifications and characteristics shall be authorized without approval of customers.

3. 5 Subcontractor control

When any part of the manufacturing process is commissioned a subcontractor, its business practices, technology, quality, and market dominance are carefully investigated, and its factory is also inspected. Following the initial approval, information exchange and quality reviews are regularly made to ensure continual improvement of quality.

4. Quality Assurance Prior to Shipping

Prior to shipping the products, they are subjected to sampling inspection for their electrical, functional and visual characteristics by lot. Aging tests are also subjected to specified lots where appropriate. Information resulting from these tests and inspections is forwarded to design and production sections to help promote quality improvement.

5. Reliability Test

A comprehensive range of reliability tests meets various purposes, such as development, production approval and new device assessment. Regular reliability tests are implemented during mass production to ensure the product reliability established at the development stage. An example of standard reliability tests is shown on **Table 1**

Table 1 Typical Reliability Test Items and Conditions

No.	Test name	Test condition	Time	r / n	Criterion
1	High-temperature operation	Ta = 125°C, V = Vopr max.	1000 h	22	Satisfies the product standard
2	Bias in high temperature / humidity *1	Ta = 85°C, RH = 85%, V = Vopr max.	1000 h	22	Satisfies the product standard
3	Pressure cooker bias*1	Ta = 130°C, RH = 85%, P = 2.3×10^5 Pa (or Ta = 125°C, RH = 85%, P = 2×10^5 Pa) V = Vopr max.	96 h (or 100 h)	22	Satisfies the product standard
4	Storage in high temperature	Ta = 150°C	1000 h	22	Satisfies the product standard
5	Storage in low temperature	Ta = −65°C	1000 h	22	Satisfies the product standard
6	Temperature cycle (Gas phase)*1	Ta = 150°C ⇔ Ta = −65°C, 15 minutes for each	500 cycles	22	Satisfies the product standard
7	Solder ability (Reflow)	T = 260°C, 10 s	3 times	22	Satisfies the product standard No abnormality by appearances
8	Solder ability *2	T = 245°C Soldering material: Sn-3.0Ag-0.5Cu	5 s	11	Zero-cross time is within 3 sec. Over 95% of a part is covered with new solder.
9	Whisker 1 (Storage in room temperature)	Ta = 30°C, RH = 60%	4000 h	6 or 9	The size of whisker is 40 μm or less
10	Whisker 2 (Temperature cycle)	Ta = 85°C ⇔ Ta = −40°C	1500 cycles	6 or 9	The size of whisker is 45 μm or less
11	Whisker 3 (Storage in high temperature / humidity)	Ta = 55°C, RH = 85%	4000 h	6 or 9	The size of whisker is 40 μm or less
12	Strength at solder joint (Shear stress)	Ta = 125°C ⇔ Ta = −40°C, Soldering material: Sn-3.0Ag-0.5Cu	2000 cycles	22	Maintains over 50% of the default strength
13	Lead strength (Pull test)	Load: Set for each lead section	30 s	11	Lead is not taken off
14	Lead strength (Bending test)	Load: Set for each lead section 45 degree bend in a lead	Twice	11	Lead is not taken off
15	ESD 1 (HBM)	V = ±2000 V, C = 100 pF, R = 1.5 kΩ Refer to V_{DD} / V_{SS}	5 times	5	Satisfies the product standard
16	ESD 2 (CDM)	V = ±500 V charged, discharged	Once	5	Satisfies the product standard
17	Latch up 1 (Pulsed current injection test)	±100 mA, V = Vopr max.	Once	5	No latch up
18	Latch up 2 (V_{supply} overvoltage test)	The overvoltage specified when V = Vopr max.	Once	5	No latch up

***1.** Test successively after the pre-treatment process.

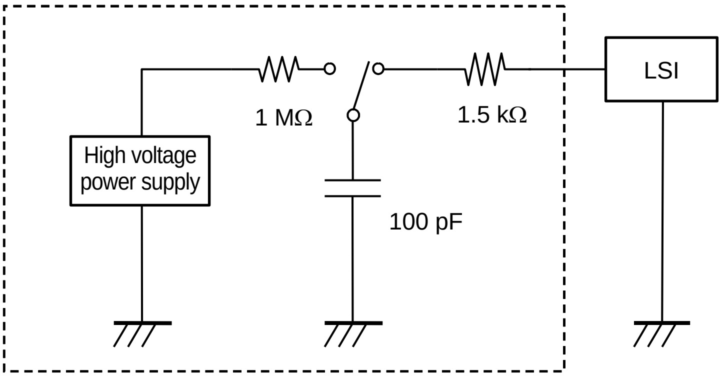
Pre treatment		
Storage in High Temperature	Storage in High Temperature / Humidity	Soldering Heat
Ta = 125°C, t = 24 h	Ta = 85°C, RH = 85%, t = 168 h	Infrared reflow, three times T = 260°C, t = 10 s

***2.** Test successively after the pre-treatment process.

Pre treatment		
Storage in High Temperature	Storage in High Temperature / Humidity	Heat treatment
−	Ta = 105°C, RH = 100%, t = 8 h	−

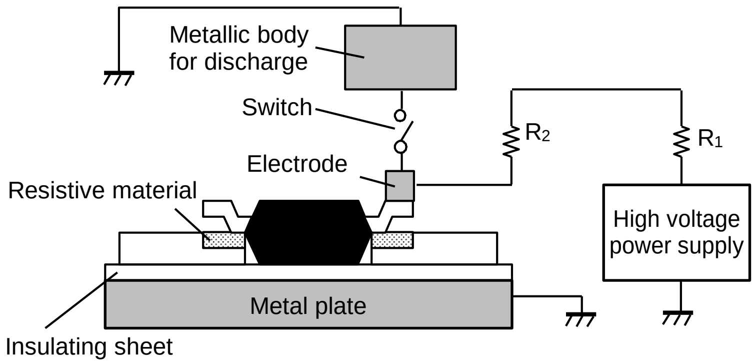
Remark Test conditions shown above are for reference only. Freely determine each test item in accordance with the type of products you select

5. 1 Static electricity resistance measurement circuit



Remark Apply voltage pulse five times.

Figure 5 Example of Static Electricity Resistance Measurement Circuit (Human body model (HBM) method)

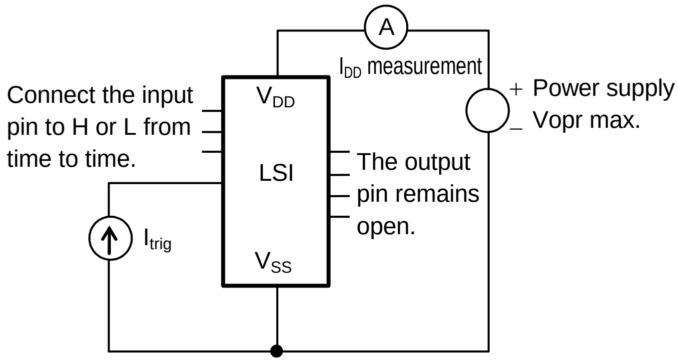


Remark Discharge once.

Figure 6 Example of Static Electricity Resistance Measurement Circuit (Charged device model (CDM) method)

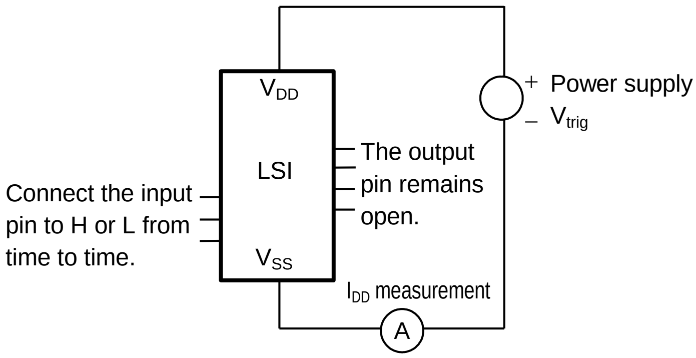
5. 2 Latch up strength measurement

(1) Pulsed current injection test (Excluding power supply pin)



Remark I_{trig}: Trigger pulse current source: ±100mA
The clamp voltage is the individually specified value.
(An example of a latch-up trigger pulse: Apply a voltage pulse once at the 10 ms pulse width.)

(2) V_{supply} overvoltage test (Power supply pin)



Remark V_{trig}: Trigger pulse voltage source
Either the voltage of Vopr max. × 1.5 or MSV (Maximum Stress Voltage)[*1], whichever is lower, is supplied as the trigger pulse voltage from when Vopr is at the maximum value.
The clamp current is the individually specified value.
(An example of a latch-up trigger pulse: Apply a voltage pulse once at the 100 ms pulse width.)

***1.** MSV : The maximum voltage that can be applied to each pin during a latch up test, without causing device destruction independent of latch-up

Figure 7 Example of Latch-up Strength Measurement Circuit

6. Customer Care Troubleshooting Flow

In the rare event that any of ABLIC Inc.'s IC products malfunctions, the product is returned to us upon request of the customer. The Sales Department contacts the customer and the Quality Assurance Department investigates and analyzes his or her complaint. The Sales Department issues a "Problem Investigation and Defect Analysis" report describing the conditions under which the product is used, and the nature of the problem. The malfunction is then analyzed based on the information. The results of the investigation are reported promptly to the design and production department to prevent any recurrence of such a case, and to further enhance the current level of quality.

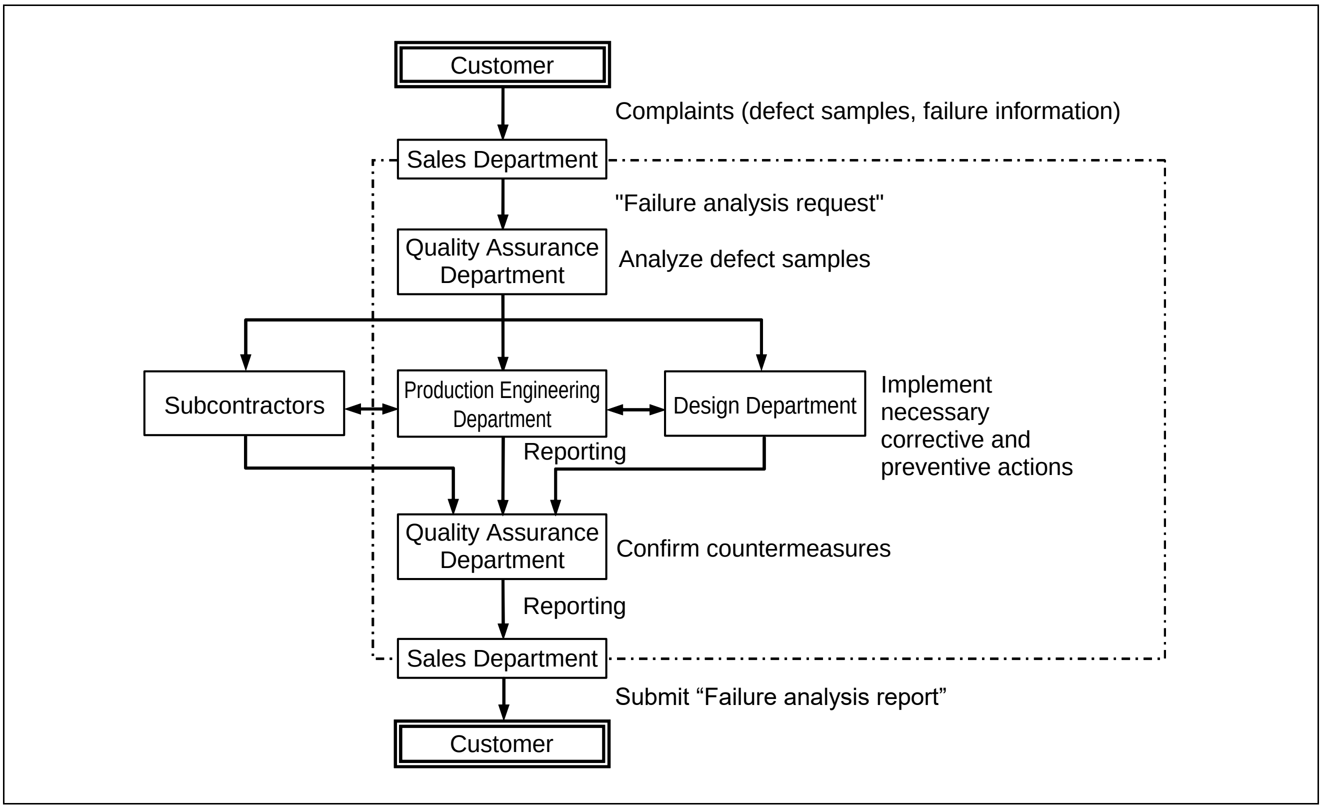


Figure 8 Customer Care Troubleshooting Flow

7. CMOS IC Usage Precautions

ABLIC Inc. guarantees that its CMOS IC products will not fail under the stresses expected to be applied in the market when used under normal operational conditions. Despite this, we would like to ask you to observe the following precautions to maximize the performance of the IC.

7. 1 System design

Use IC products within the specifications of operating voltage, operating temperature, input / output voltage, current and other electrical characteristics. Failure to do so may lead to a problem or a malfunction in your system.

7. 2 Assembly and measurement

IC products may be broken due to static electricity because all pins are opened many times when assembled and measured. Always observe the following:

- Wear an anti-static electricity factory uniform and ground through human body.
- Handle IC products on the grounded conductive mat or a metallic board.
- Turn off the PCB's power supply when inserting and removing the IC.
- Ground the soldering machine and solder iron.
- Keep room humidity between 40% RH and 70% RH.

7. 3 Transport

Use conductive containers to avoid a breakage due to static electricity. Especially, safeguard the containers against mechanical vibration, physical impact, and sudden or drastic temperature fluctuation during transportation.

7. 4 Storage

Always observe the following:

- Do not leave the ICs in any place at high temperature and high humidity, leading to drastic fluctuations in temperature, generation of large quantities of stains and dirt or corrosive gas.
- The epoxy resin used in the packages can absorb moisture from the air which can cause internal peeling and cracks in the resin, so it is recommended that the ICs be stored in low humidity environments. The ICs can be stored at a temperature of 5°C to 30°C and relative humidity of 40% RH to 70% RH. It is recommended they be used within 1 year of delivery.
- Do not apply excessive force to ICs when packed and stored because it may deform their lead pins.
- Preferentially use anti-static and clean packaging materials.
- Preferentially put the ICs into a dry box (an atmosphere of dry N_2 gas) in case of storage of over 6 months.
- Processed ICs (ICs that have been soldered or had lead pins bent, etc.) may suffer from impaired solder wettability or become difficult to be mounted on boards. Store ICs under pre-processing conditions.
- Products which are packaged in moisture-proof packaging should be stored unopened at a temperature of 5°C to 30°C and relative humidity of 40% RH to 70% RH and should be used within 12 months (it is recommended they be stored in a dry box). After opening, store them in environments according to individual specifications and use them within the specified time periods. If not used during the specified storage period, or if desiccant absorbed moisture, it is recommended they be baked according to the individual specification conditions.

8. Package Mounting Precautions

8. 1 Rinse

When rinse-free flux is applied, rinsing is not necessary. It may cause corrosion when residue of the active agents remained in the flux. Good selection of flux is indispensable to avoid corrosion.

Avoid chlorinated and chlorofluorocarbon-based solvents, and use specialized flux rinsing agents, isopropyl alcohol, pure water, etc. for rinse. Avoid high temperature, rapid heating, and rapid cooling for ringing agents and drying temperatures.

If performing ultrasonic cleaning, do the processing in the shortest possible time, and ensure the products being cleaned do not resonate. Please note however that some products are not compatible with ultrasonic cleaning, so consult with the ABLIC Inc. Quality Assurance Department before use.

8. 2 Resistance to soldering heat (Reflow soldering, flow soldering and soldering iron)

8. 2. 1 Reflow soldering (Surface mount packages)

The temperature rise may be different in the resin and a terminal part due to the reflow soldering.
It is necessary to check the package surface temperature (resin) before setting the temperature profile.
Figure 9 shows the resistance to soldering heat condition for package (Reflow method).
Confirm the heat resistance of the package shown below (Based on JEDEC J-STD-020).

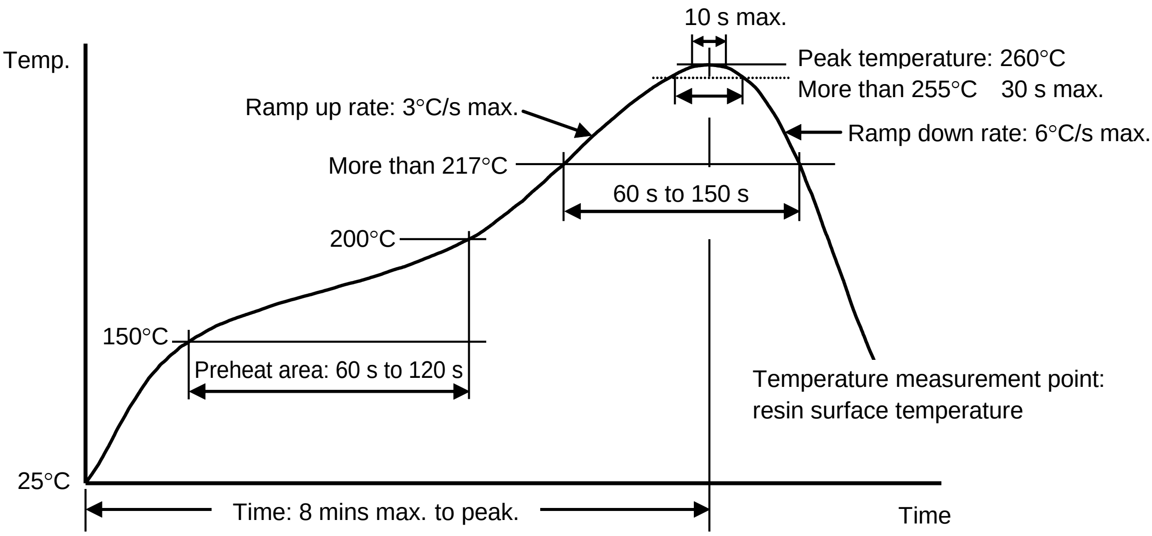


Figure 9 Resistance to Soldering Heat Condition for Package (Reflow Method)

Remark Number of maximum reflow cycles: three times (However products may have separate individual specifications so verify the content of the delivery specifications.)

8. 2. 2 Flow soldering (Insertion mounting packages and flow compatible surface mounting packages)

Flow soldering gives larger thermal stress to the package compared to reflow. Preheating is indispensable to relax the thermal stress.

Figure 10 shows the resistance to soldering heat condition for package (Flow method).

Confirm the package of heat resistance in the following range.

The peak temperature of flow soldering at 260°C for 10 seconds or less (Preheating temperature and time are the reference value).

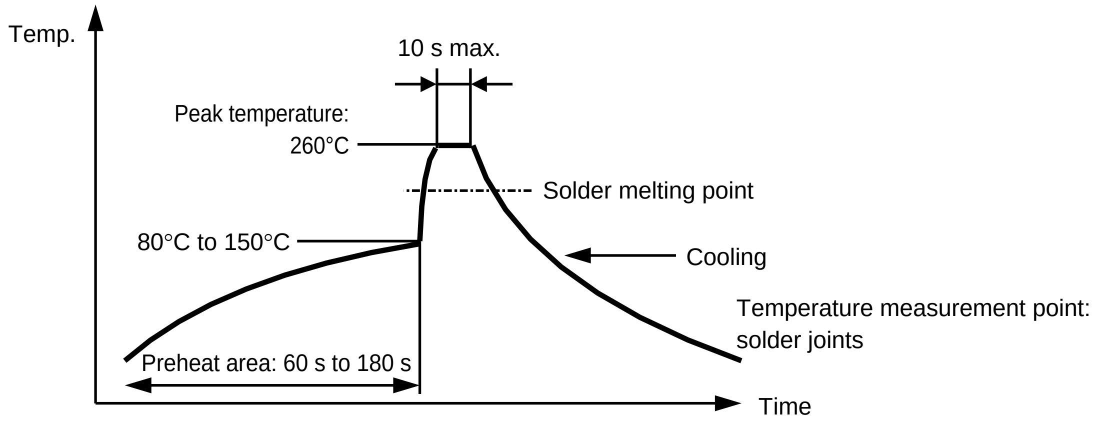


Figure 10 Resistance to Soldering Heat Condition for Package (Flow Method)

Remark Number of maximum flow cycles: Once

8. 2. 3 Soldering iron (Soldering iron compatible packages)

When using a soldering iron or heating collet, you should observe the following precautions only to a terminal part and operate it for each terminal part.

- The maximum temperature of the soldering iron: 380°C
- Heating time: 5 seconds or less
- Number of maximum iron cycles: Two times

Remark Not applicable for non-lead packages such as HSNT, DFN, QFN, and solder bump type packages such as WLP.