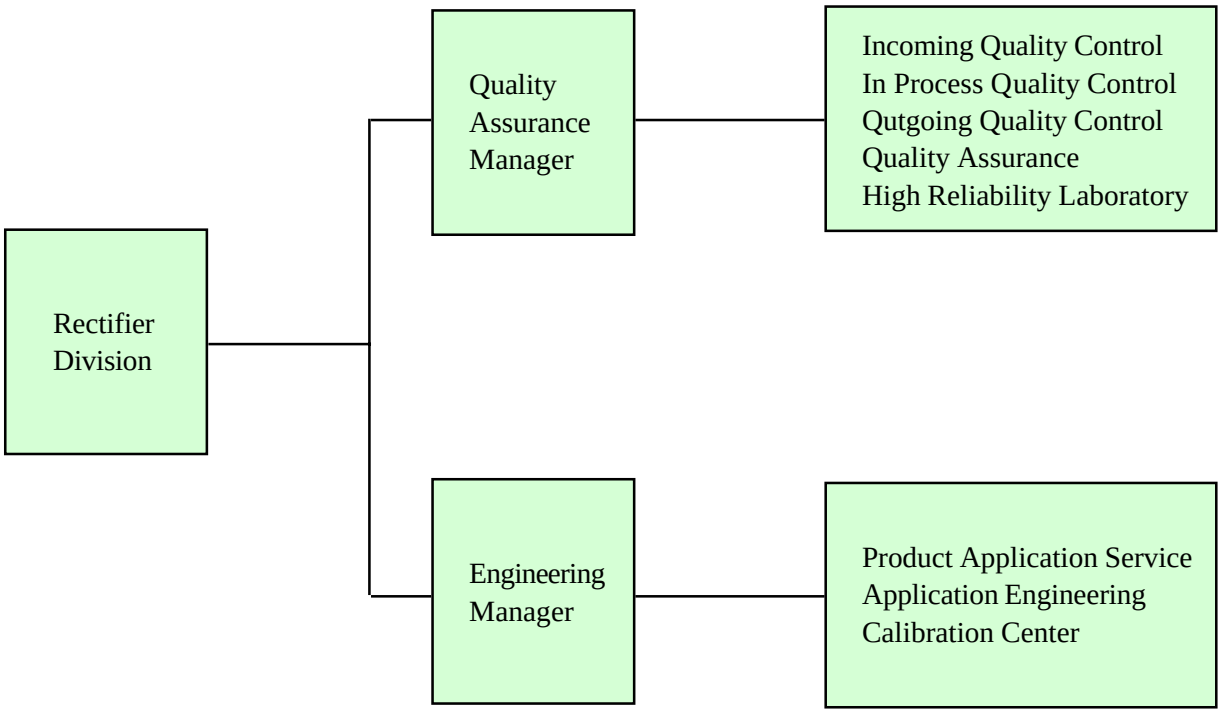
RECTRON QUALITY / RELIABILITY PROGRAM

1-1 Quality Control System-Basic Concepts

Rectron first achieved ISO-9000 status in 1994. Naturally, Rectron has modeled its internal quality and rcliability standards around the ISO-9000 model. In June 1999, Rectron will take the next stop by fully implementing QS9000, a quality standard devoted to the harsh under-hood requirements of the automotive industry. In addition, all departments are required to attend regularly schedule training sessions on topics such as Statistical Process Control (SPC), Just-Time (JIT), Zero Defect Programs, and TQM.

The information listed below is intended as a general overview of Rectron's quality and reliability capabilities. Further details and explanations can be found in the Rectron Quality Manual.

1-2 Reporting Flow Chart



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1-3 Quality Control Flow Chart

In process quality control (IPQC) is a key element of the Rectron quality process. Below is a flow chart of major in process QC inspection points from wafer process to final shipment.

FIG.1 Folw Chart of the Manufacturing Process

PROCESS	DESCRIPTION
Raw Material Input	* Parts received from approved supplier.
Incoming Inspection	* Perform incoming inspection of parts and material and record the results.
Wafer Fabrication	* Breakdown voltage, function test etc. Inspected to assure lot quality.
In-process Inspection-I	* Furnace profile checked bi-weekly.
Soldering	
Inprocess Inspection-II	* Die size control.
Etching	
Junction Coating	* Process condition of curing and timing control..
Molding	* Molding of plastic encapsulated device temperature, pressure and clamping time Verification.
In-process Inspetion-III	* Visual, mechanical inspection.
Plating	* Temperature, PH value, and timing verification.
In-process Inspection-IV	* Visual inspection, solderability thickness test. * Special test of temperature cycling, gross and fine leak lest.
4-Bin Sorting Tester	
Marking & Elect.Test	* Marking legibility marking, correct electrical-polarity function.
In-process Inspection-V	* Electrical function, cosmetic, dimension test.
Visual Inspection & packing	* Bulk / tape-reel packing verification.
Lot Outgoing Quality Control or Final Inspection	* Electrical characteristics, external visual and verification of any special customer specification.
Warehouse	
Quality Audit	* QA audit for Packing of carton, inner box.
Shipment	

1-4 Main Function of Quality Control Departments

1-4-1 I.Q.C (Incoming Quality Control)

1. New vendor evaluation.
2. Vendor survey.
3. Incoming (materials, parts, chemicals) inspection.
4. Incoming quality analysis.
5. Purchasing specificaitons.
6. Lead evaluation.
7. Wafer analysis.
8. Solder analysis.
9. Silicon rubber function test.
10. Molding compound evaluation.
11. Correctuve action follow up for defective materials.
12. First in, first out check.

1-4-2 I.P.Q.C (In-Process Quality Control)

1. Quality control.
2. Processing analysis.
3. Statistical analysis.
4. Failure analysis.
5. Soldering analysis.
6. Etching analysis.
7. Control charts.
8. Engineeing change notifications
9. Review of operating insructions.
10. Production yield analysis.
11. Scrap material control.
12. Rejected lot analysis.
13. Corrective action.
14. Check testing equipment calibration.
15. Pull, break, bend, twist and flammability tests.

1-4-3 O.Q.C. (Outgoing Quality Control)

1. Outgoing inspection and product analysis.
2. Customer specification review.
3. Internal specificaions review.
4. Routine inspections / customer records.
5. Documentation check.
6. Provide certification.
7. Statistical analysis.
8. Correlation with customer.
9. Sampling check.
10. Package standards review.

1-4-4 HI-REL (High Reliability Laboratory)

1. Environmental and life qualification assurance
   * Terminal strength
   * Solvent resistance
   * Solderability
   * Solder resistance
   * Forward surge
   * Temperature cyling
   * Thermal shock
   * Humidity test
   * Pressure cooker test
   * Operating life
   * Thermal fatigue
   * High temperature reverse bias
   * High temperature storage
2. Product family surveillance analysis.
3. Customer specification qualification.
4. Test procedure set up.
5. New process device & packing evaluation
6. Failure analysis.
7. Corrective action.
8. Product standards.

1-4-5 QA (Quality Assurance)

1. QC system evaluation.
2. Quality cost evaluation.
3. Calibration system monitoring.
4. Specification & drawing review.
5. Quality improvement activities.
6. Quality control circle.
7. PPM Program.
8. Design review.
9. Review first-in first-out at warehouse of finish products.

1-4-6 QS (Quality Service)

1. Reply to customer's claim.
2. Marketing quality survey.
3. Failure mode defects analysis, and verification.
4. Product shipment, packing and storage analysis.
5. Product safety specification review.

1-4-7 A.E. (Application Engineering)

1. Sample order prepartion.
2. Issue internal product specifications.
3. Customer specification review.
4. Evaluation of new products.
5. Product failure analysis.
6. Catalog and data sheet preparation.
7. Rectifier application consulting.

1-4-8 Calibration Center

1. Equipment calibration and set up.
2. Evaluation, calibration and accuracy checking of new Equipment.

1-5 Reliablity Experiment

Item Test	Condition	Rdeference
1. Solder Resistance	@260 ± 5^{0}C for 10 ± 2 sec. Immerse body into solder 1/16" ± 1/32"	MIL-STD-750C METHOD-2031
2. Solderability	@230 ± 5^{0}C for sec.	MIL-STD-202F METHOD-208
3. Pull	1 Kg in axial lead direction for 10sec.	MIL-STD-750C METHOD-2036
4. Bend Lead	0.5 Kg weight applied to each lead bending are 90^0 + 5^0 for 3 times.	MIL-STD-750C METHOD-2036
5. High Temperature Reverse Bias	VR=80% rated @T_A=100^{0}C125^{0}C for 1000hrs.	MIL-STD-750C METHOD-1026
6. Forward Operation Life	rate average rectifier current @ T_A= 25 ^{0}C for 500hurs.	MIL-STD-750C METHOD-1027
7. Intermittent Operation Life	on state: T_J=125 ^{0}C-175 ^{0}C with rated I_{RMS} power for 5min. off state: T_J=T_A+15 ^{0}C with cool forced air, on and off for 1000 cycles	MIL-STD-750C METHOD-1036
8. Pressure Cooker	15 PSIG @T_A=121 ^{0}C for 4hurs	
9. Temperature Cycling	-55/-65^{0}C+125^{0}C/150^{0}C dwelled for 30min. and transferred for 5min. total 10 cycles	MIL-STD-750C METHOD-1051
10. Thermal Shock	0 ^{0}C for 5min. Rise to 100 ^{0}C for 5min total 10 cycles	MIL-STD-750C METHOD-1056
11. Forward Surge	8.3ms single half sine-wave superimposed on rated load, one surge	MIL-STD-750C METHOD-4066-2
12. Humidity	@ T_A=65 ^{0}C, RH=98% for 1000hurs.	MIL-STD-202F METHOD-1038
13. High Temperature Storage Life	@ 150 ^{0}C for 1000hurs.	MIL-STD-750C METHOD-1031
14. Solvent Resistance	dip into freon @ 25 ^{0}C for 1min.	MIL-STD-202F METHOD-215

* Rectron Ltd. Performs the above reliability experiments by using MIL-STD-19500.

1.6 Calibration System

	CALIBATION BY		
EQUIPMENT	INTERNAL OR EXTERNAL	ORGANIZATION	CYCLE
DIGITAL MUL TIMETER OSCILLOSCOPE	External	Electronics Research & Service Organization (ERSO) National Taiwan Institute of Technology (NTIT) Electronics Testing Center Taiwan (ETC)	6 Mon.
MEASURING INSTRUMENT	External	National Burean of Standard, Ministry of Economic Affairs	1 Year
TESTING INSTRUMENT	Internal	Calibration Standard Center	3 Mon.
MEASURING INSTRUMENT	Internal	Calibration Standard Center	6 Mon.

1-7 Quality Improvement and Monitoring Program

Purpose : To measure the effectiveness of test and inspection programs and to monitor the long-term reliability of current products and processes. Parts are randomly sampled from production and subjected to the follwing test :

1-7-1 Weekly Test

1-7-1-1 High Temperature Storage :

To determine electrical and mechanical charateristics of device. (at T_J maximum / 24 hrs.)

1-7-1-2 Solderability :

To determine the solder coverage on the device. (MIL-STD-202F method 208)

1-7-1-3 Solvent Resistance :

To verify that the marking or color-coding will not become illegible discolored or show any other type of deterioration. (MIL-STD-202F method 215)

1-7-2 Monthly Test

1-7-2-1 Solder Resistance : (MIL-STD-750C, method 2031.1)

To determine the device resistance to the high temperature encountered during soldering operation

$T_A = 260 \pm 5\ ^0C$ / T = 10-12 sec.

1-7-2-2 Humidity Test : (MIL-STD-202F, method 103.1)

To evaluate the properties of materials subjected to high humidity. Condition :

RH = 98% / $T_A = 65\ ^0C$ / T = 24-1000hrs

1-7-2-3 Pressure Cooker :

To verify the properties and quality of the molding compound

$T_A = 121^0C$ / 15 PSIG / T = 24-96 hrs.

1-7-2-4 Temperature Cycling : (MIL-STD-750C, method-1051)

To determine the resistance of the device to expose to extreme high and low temperature.

Condition :

T_H = 125 ^{0}C / 150 ^{0}C	30 min.
T_R = 25 ^{0}C	15 min.
T_C = -55 ^{0}C / -65 ^{0}C	30 min.

1-7-2-5 Thermal Shock : (MIL-STD-750C, method-1056)

To detemine tha resistance of ht device with suden extreme changing temperaure.

Condition :

T_H = 100 ^{0}C / 125 ^{0}C / 150 ^{0}C	5 min.
T_C = 0 ^{0}C / -40 ^{0}C / -55 ^{0}C / -65 ^{0}C	5 min.

1-7-2-6 Forward Life : (MIL-STD-750C, method-1027)

To determine the ability of the device to withstand operation at rated forward current.

1-7-2-7 Forward On-Off Life Test : (MIL-STD-750C, method-1036)

To determine electrical application of the device with practical simulation.

1-7-2-8 High Temperature Reverse Bias : (MIL-STD-750C, method-1026)

To determine characteristics of device under high temperature reverse bias.

1-7-2-9 High Temperature Stroage : (MIL-STD-750C, method-1031)

To determine electrical and mechanical characteristics of device under high temperature conditions.

1-7-3 Test and Measure Quarterly

1-7-3-1 Vibration Test : (MIL-STD-202F, mathod 201A)

To evaluate the endurance of a device against vibration.

1-7-3-2 Impact Shock : (MIL-STD-202F, method 207A)

To determine the ability of various parts to withstand shock.

1-7-3-3 Thermal Resistance : (MIL-STD-750C, method-4066-2)

To test the devices thermal resistance between junction and ambient.

1-7-3-4 Forward Surge : (MIL-STD-750C, method-4066-2)

To determine the surge capability of the device.

1-7-3-5 Terminal Strength : (MIL-STD-750C, method-2036)

To determine the mechanical / stress ability of the device.

1-8 Corrective Action Report (CAR) and Return Material Authorization (RMA) System

1-8-1 CAR procedure

A “48hrs. Response Form” will be completed and faxed to the customer within 48hrs. of the initial notification by the customer. Suspect samples will be requested for evaluation. Once received, the suspect samples will be evaluated locally to verify the failure mode. Depending on the level of failure, all local inventory and factory WIP will be quarantined until root cause can be found, An 8D team will be appointmented in serious cases.

The suspect samples will be expressed within 24hrs. to the appropriate Quality personnel at the Rectron (Taiwan) or Rectron(Malaysia) manufacdturing facility for evaluation. It takes approx. 4 working days for the samples to clear customs and reach their destination. A final Corrective Action Report will be issued within 10 working days of receiving the samples. In total, the customer will receive an answer within 15 working days of Rectron receiving the suspect samples.

The CAR will explain the root cause of the problem, recommendation for disbursement of current stock, needed corrective actions taken to ensure the problem will not reoccur, and effective dates.

1-8-2 RMA Procedure

The complete RMA procedure is covered under QC inspection instruction no. P700004 rev.

B. An RMA number if deemed necessary will be generated and expedited to the customer once the corrective action report is issued.

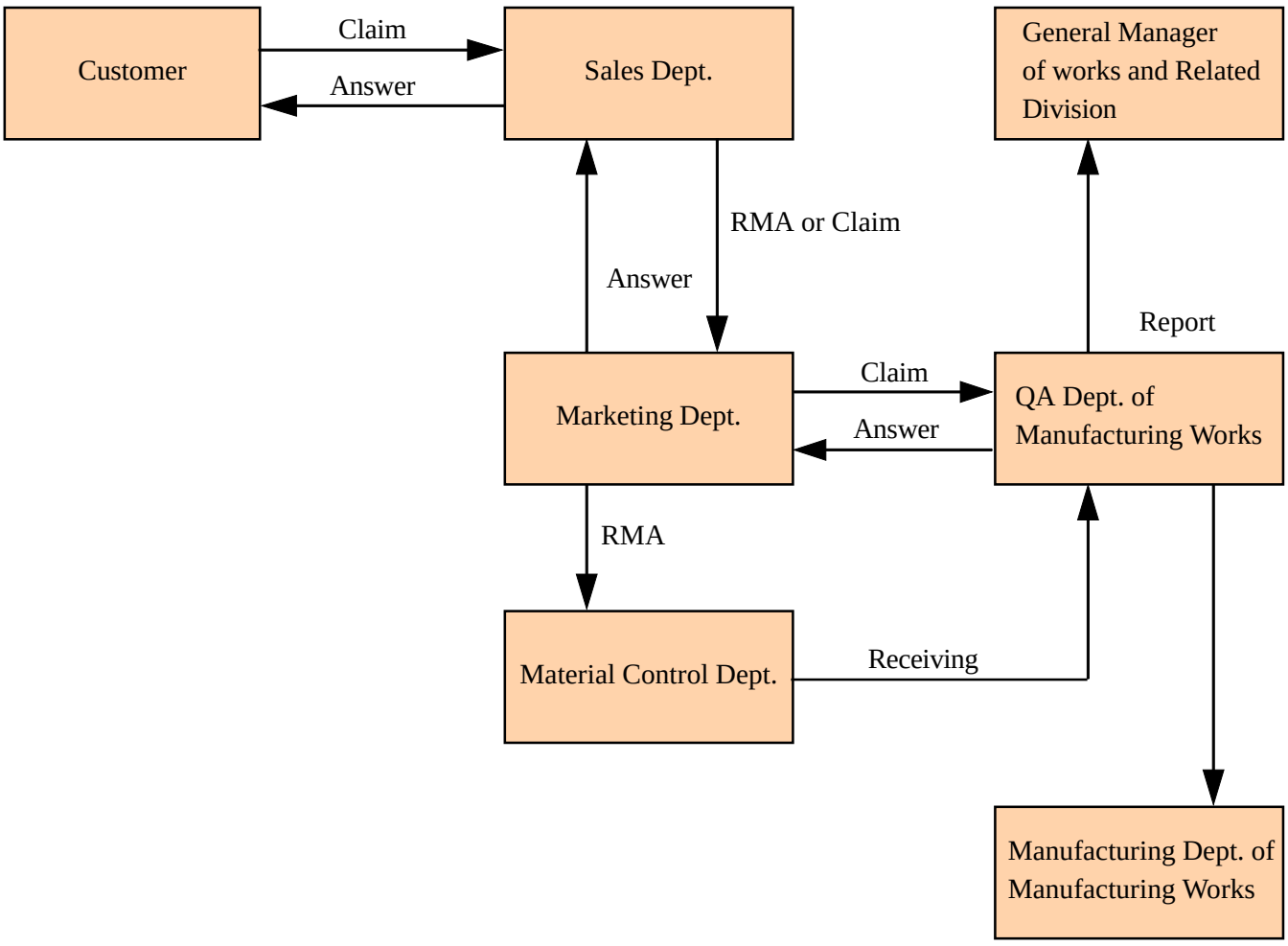
1-8-3 Specifiation and QA Contract

Performance, quality and reliabiltiy levels required by each customer are documented in their specificaion or QA contract prior to the delivery of any product. This specification control program requires a good working relationship with the customer in which information is exchanged which reveals potential problems and prevents misunderstandings. This includes the identification of defective items, verification of defective products and analysis of the causes, prompt feedback of the result, and support for the quality requirement of the customers in product acceptance, manufacturing process, and marketing.

1-8-4 Discrepancy Returns

Analysis and action procedures have been established as shown in FIG 2, for prompt handing of claims from the customer. This information is treated statistically by our quality memorandum retrieval system, and the results of the analysis is fed back to the responsible department. The manufacturing process information is then utilized to prevent reoccurence and for improvement of reliabilty.

FIG 2 System of Quality Service & Claim Action Route (reference : marketing flow No. 059 date : 04-26-88)



RMA : Return Material Authorized

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