No.1020006

LSI:Adds the Lapis Miyagi as a newly manufacturing site for 0.18um memory products as a part of BCP

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14th July 2020

ROHM Co., Ltd.
Takashi Shimane / Division Manager / WP Control Div. WP Production Headquarters

1．Summary of the change

1-1) Purpose of change

・Establish multiple manufacturing resources for the stabilized product supply by transferring some products from Rohm Kyoto to LAPIS Miyagi factory.

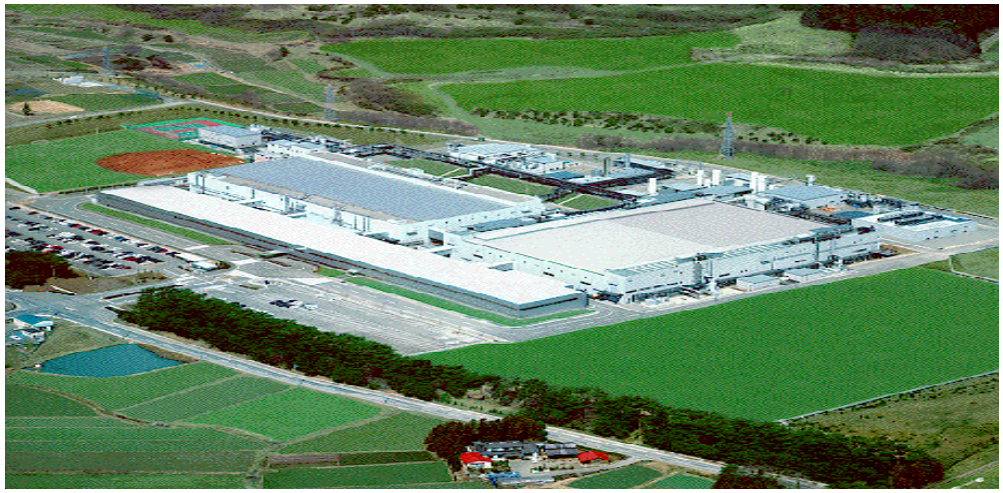
1-2) Contents of change

・Add Lapis Miyagi factory for application of 0.18um memory product of the wafer process producing.
The quality characteristics are guaranteed by LAPIS Miyagi, which has produced products from 2013 in the same line as that of Rohm Kyoto.
(There is not a change about the assembly factory after the wafer process shipment)

1-3) Schedule of change

・We plan to change it immediately after your approval acquisition, because LAPIS Miyagi factory has mass-produced from 2013.
It becomes the intensive production in LAPIS Miyagi after approval from the viewpoint of production efficiency.

2. Summary of LAPIS Miyagi factory



2-1) LAPIS Miyagi factory summary

Company name：LAPIS Semiconductor Miyagi Co., Ltd.
Location：1, Okinodaira Ohira-mura Kurokawa-gun, Miyagi
Establishment：8/4/1988
Representative：Naotaka Fujita (President)
Production item：Monolithic IC（LSI）
Production Capacity：LSI 25,000～35,000 wafers(200mm)/ a month
Employee：229

2-2) LSI 0.18μm PRODUCTION RESULTS

(Transfered products of the wafer process producing in Rohm Kyoto factory to LAPIS Miyagi factory)

START OF PRODUCTION ： Dec. 2013
PRODUCTION VOLUME ： 79,000wafers
Smallest Design Rule：0.13um

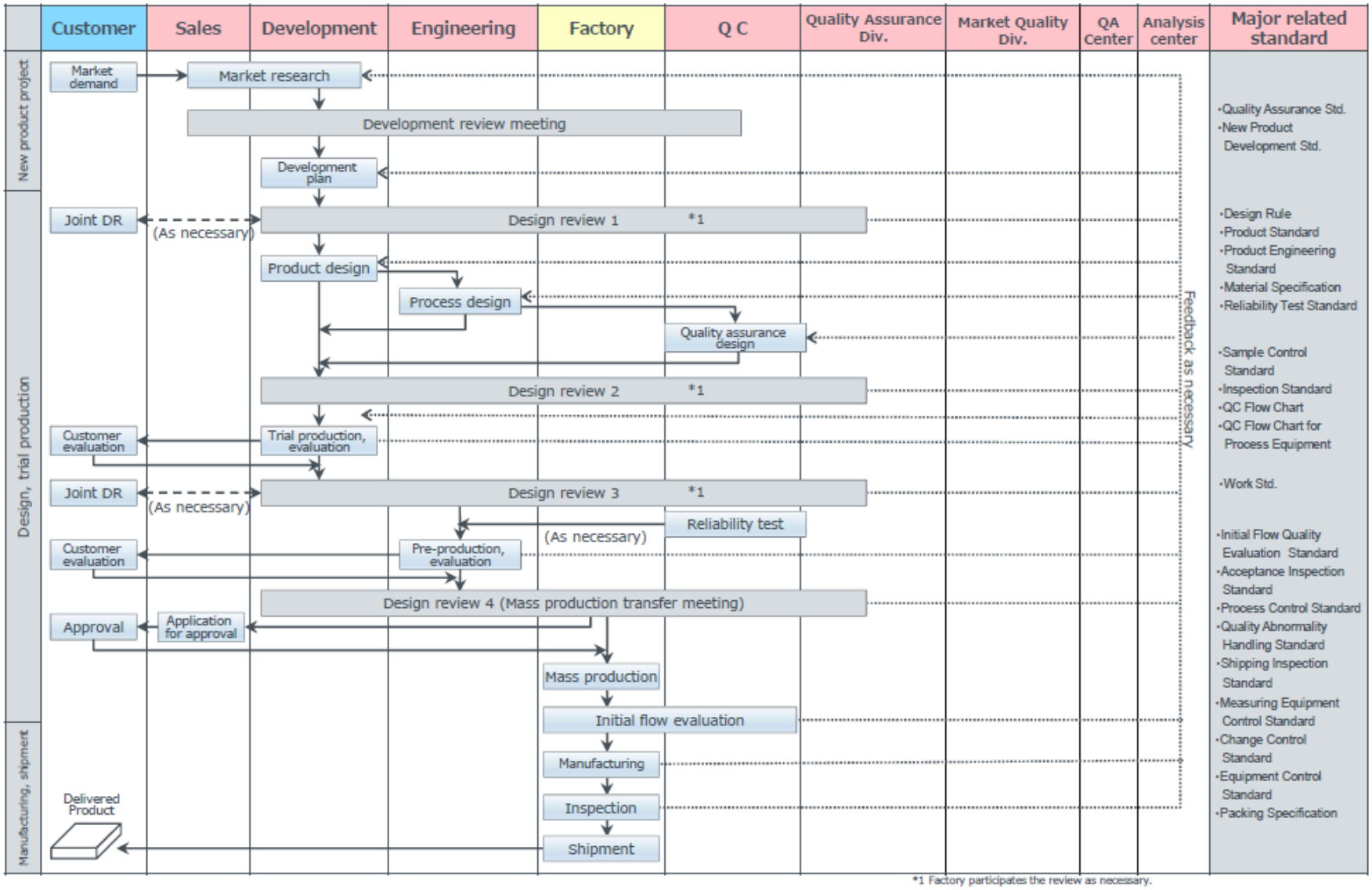
2. Summary of LAPIS Miyagi factory

2-3) Environmental management (clean room)

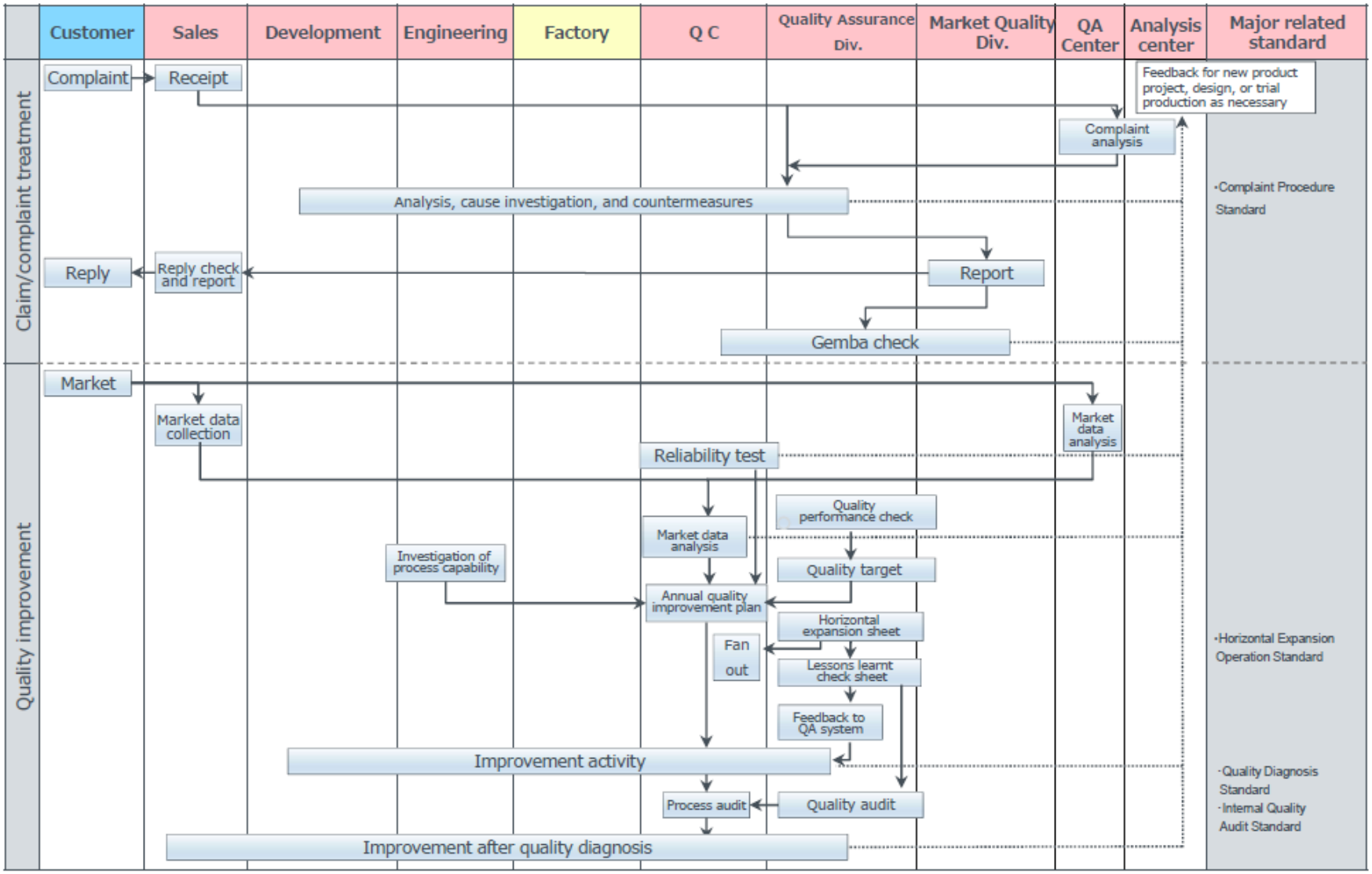
ITEM		FREQUENCY	METHOD	UNIT	Management Value	Rohm Kyoto (Existing)	LAPIS Miyagi (New)
Temperature		Continuous Monitoring	Thermometer	℃	23±1	22～24	22～24
Humidity		Continuous Monitoring	Hygrometer	%	45±10	40～50	40～50
Cleanliness	Passage Area	Continuous Monitoring	Measure by Laser Dust Counter	pcs/cf	35 (0.1um)	Less than 10	Less than 10
	Operation Area	Continuous Monitoring		pcs/cf	35 (0.1um)	Less than 10	Less than 10
	MASK Area	Continuous Monitoring		pcs/cf	35 (0.1um)	Less than 10	Less than 10
Smallest Design Rule (um)						0.13	0.13

There is no difference about the environmental management (clean room) between the factories.

3 . Quality assurance system(1/2)



3 . Quality assurance system(2/2)



There is no change about Quality assurance System

4 . Change point of 5M with the factory transferring

5M		Rohm Kyoto	LAPIS Miyagi	Comparison
Man	-	The worker who was authorized in a license system in the company operate according to operating procedures.		Equal
Machine	Equipment in use	Existing device (the same method)		Equal
	Factory management contents	Conforming to QC chart.		Equal
	Management method	In accordance with facilities QC chart, carrying out SPC management.		Equal
	Transport between equipments	Cart / Robot Cart	OHV(Overhead Hoist Vehicle)	Different ※1
Materials	Wafer	200mm Si wafers		Equal
	Others	same thing is used by centralized supply system.		Equal
Method	Processing condition	Conforming to QC chart.		Equal
	Treatment of the control limits out	Conforming to quality abnormality measures rule.		Equal
	Inspection contents	Conforming to inspection standard.		Equal
Measurement	Measuring equipment ※2	Although there is difference in the device by the wafer diameter, equipment is calibrated in equal standard such as precision and repeatability .		Equal
	Management method	Conforming to measure administrative provision.		Equal

※1 About the Transport between equipments, Rohm Kyoto line uses a cart or automatic robot cart but LAPIS Miyagi line uses OHV(Overhead Hoist Vehicle).

And the wafer storing container is changed to FOUP (Front Opening Unified Pod) from BOX type.

The tolerance for the floating dust greatly improves.

※2 The measuring equipment refers to the equipment of the film thickness, Electric characteristic, Dimensions, Resistivity, Reflectance, Refractive index and Particle.

5. Investigation for the change point of 5M (process)

5-1) Target process

Process		Existing	New
Wafer Process	STI GATE Metalization Passivation	**Rohm Kyoto**	**LAPIS Miyagi**
Assembly Process	Wafer Probe Test Dicing Assy	No Change	
Test Process	Final Test	No Change	

It is only wafer process to perform change application this time.
Assembly and Test process does not have the change.

5. Investigation for the change point of 5M (process)

5-2) Process capability of primary characteristics of main process

We compared the process capability of Rohm Kyoto with LAPIS Miyagi referring to primary characteristic of main processes.
it has more than Cpk1.66 and does not have any problem.

	Rohm Kyoto			LAPIS Miyagi		
Item	σ	Cp	Cpk	σ	Cp	Cpk
GATE Oxide Thickness	2.53	2.63	2.14	3.23	2.06	1.81
GATE POLY size	0.006	1.73	1.68	0.005	2.14	1.93
CONT size	0.004	2.21	2.03	0.003	2.50	2.14
1st Metal size	0.004	2.02	1.77	0.004	2.20	2.18

n=20Lot each
25point/Lot

5. Investigation for the change point of 5M (process)

5-3) Process capability of main element properties

We compared the process capability of Rohm Kyoto with LAPIS Miyagi referring to characteristic of main elements.
it has more than Cpk1.66 and does not have any problem.

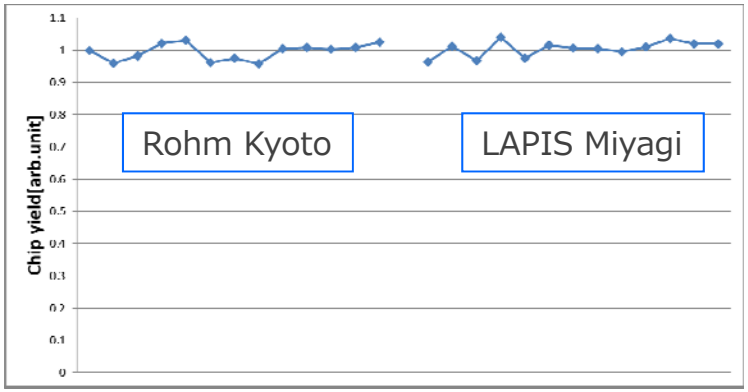
	Rohm Kyoto			LAPIS Miyagi		
Item	σ	Cp	Cpk	σ	Cp	Cpk
NMOS Vth	0.02	1.86	1.81	0.02	1.82	1.74
PMOS Vth	0.02	1.86	1.79	0.02	1.96	1.72
Memory 1Vth	0.27	2.08	2.01	0.27	2.03	1.92
Memory 0Vth	0.27	1.82	1.79	0.22	2.25	2.25
CONT CR	0.60	2.22	2.11	0.33	4.02	3.78
VIA CR	0.40	2.07	2.04	0.44	1.88	1.86

n=20Lot each
25point/Lot

5. Investigation for the change point of 5M (process)

5-4) CHIP Yield(WA mearurement)

We compared the CHIP yield of Rohm Kyoto product with LAPIS Miyagi product.
There is no difference in CHIP yield of both lines on a monthly basis for the most recent year.



5-5) Reliability evaluation result of the wafer level

We show the reliability evaluation result of the wafer level at 0.18um memory line as follows.
All tests satisfy a criterion and do not have any problem.

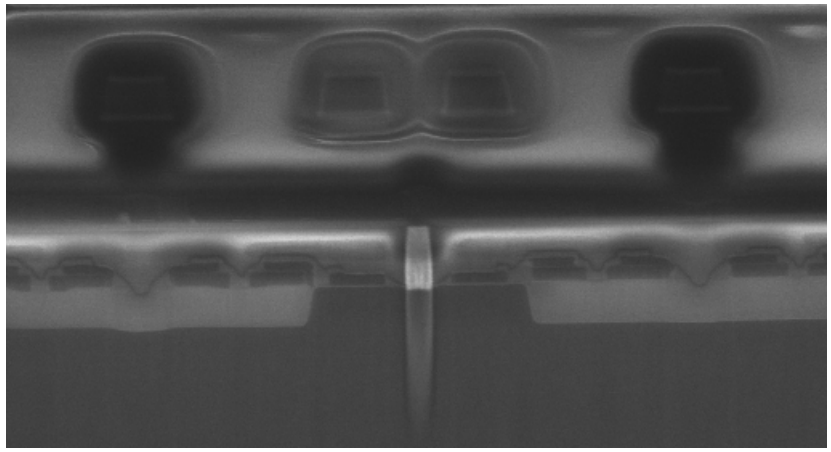
Test Item	Test symbol	Evaluation Criteria				Results judgment
		judgment	Temperature	Voltage/Current	life	
Gate oxide film	TDDB	0.1%defective rate	150℃	Vccmax:5.5V	20years	Pass
Slow trap	NBTI	ΔIdsat≧10%	25℃	Vccmax:5.5V	20years	Pass
Hot carrier	HCI	ΔIdsat≧10%	150℃	Vccmax:5.5V	20years	Pass
Stress migration	SM	ΔR≧10%	150℃	-	20years	Pass
Electro migration	EM	ΔR≧10%	150℃	I=1mA/um	20years	Pass

5. Investigation for the change point of 5M (process)

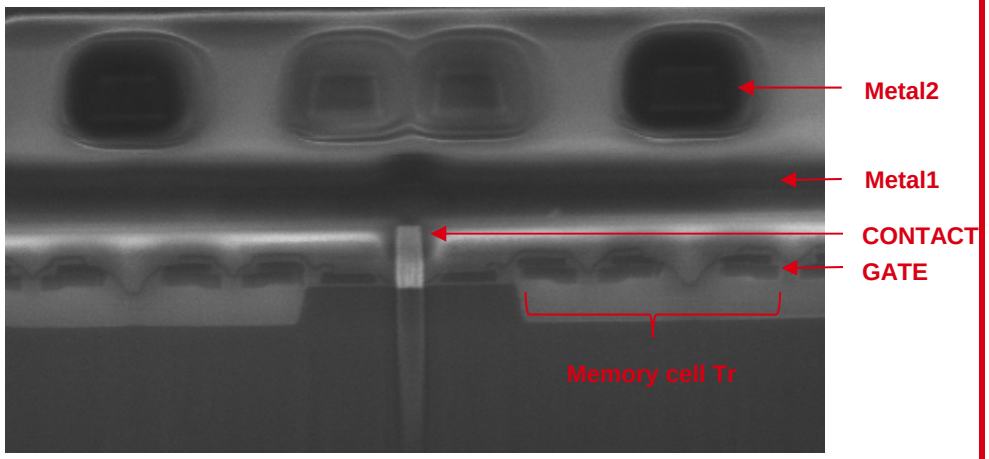
5-6) Cross sectional structure evaluation

The wiring structure of each sample of Rohm Kyoto/LAPIS Miyagi were observed by using FIB.
There is not the difference in structure between Rohm Kyoto/LAPIS Miyagi .

Rohm Kyoto



LAPIS Miyagi



6. Investigation for the change point of 5M (product)

6-1) QAT(Quality Approval Test) result

We show the result of the QAT that were executed on the other product at LAPIS Miyagi line, as follows.
All test results satisfy a criterion and do not have any problem.

Test Item	Test symbol	The number of samples	Evaluation Criteria	Test condition	Test time /cycles	Results judgment
Pressure Cooker test	PCT	77pcs×3	Need to clear the spec of specifications and standard of shipment by the FT measurement after the test.	121℃/100%RH 2atm	500h	Pass
Temperature cycle test	TCY	77pcs×3		-65℃ ⇔ 150℃	1000cyc	Pass
High Temperature Storage test	HST	77pcs×3		150℃	2000h	Pass
High Acceleration Stress test	HAST	77pcs×3		VDD/130℃/ 85%RH	200h	Pass
Dynamic Burn in test	B/IN	77pcs×3		VDD/150℃	2000h	Pass
ESD Test (HumanBodyModel)	HBM	3pcs	Over 2000V	100pF/1.5kohm	-	Pass
ESD Test (Machine Model)	MM	3pcs	Over 200V	200pF/0ohm	-	Pass

7. Summary

From the above evaluation and inspection,
We judge the quality characteristic of the front-end 0.18um memory products in Kyoto is equal even if the Lapis Miyagi factory is added, and We have pushed forward product transference.

About the product for your company, we are going to change it immediately after the approval acquisition.

We would like your confirmation.

ROHM Co.,Ltd.