



QMEMS

AT Crystal for automotive FA-238A

2012/7

Seiko Epson

Micro Device TD Sales Department



- ◆ Termination for FA-23AP product release
 - Limited frequencies (Photo chip)
 - High ESR

- ◆ Upgrade FA-238V, FA-238 to automotive grade
 - Using the current product line up
 - Optimizing to automotive grade with some changes

Our Automotive Quality grade

Automotive grade
(Class 1)

For Safety application

We develop the design and manufacture to support the requirement.
We also support Functional Safety standard (ISO26262)

Automotive grade
(Class 2)

For Automotive application (Body, Multimedia)

We develop the design and manufacture to support the requirement.
We support PPAP, AECQ200 as standard.

Automotive grade
(Class 3)

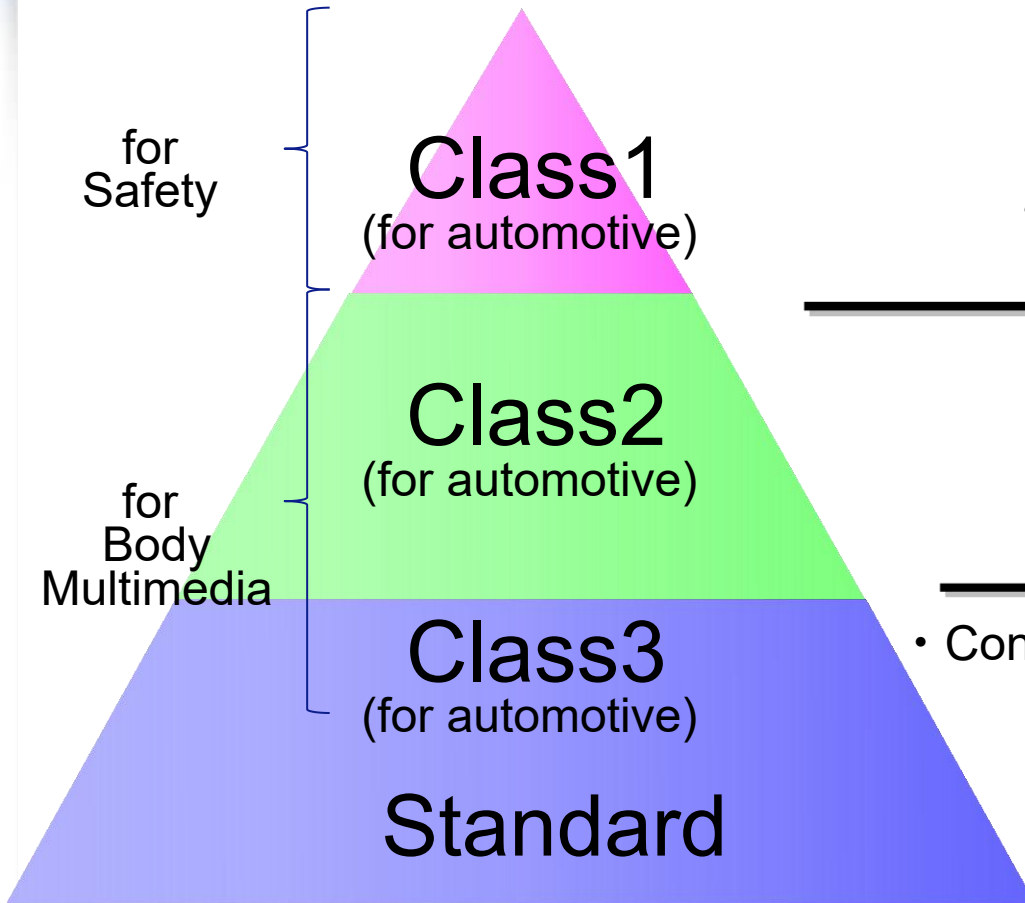
For standard part

We make production controls and tighter inspection comparing to standard grade.
We support PPAP, AECQ200 based on requests

Standard grade

For standard part

We develop the design and manufacture based on our quality assurance regulation



- AECQ-001/002
 - Complied with Maverick
 - Separated serial number control
 - Data/sample 15years storage
 - Product/Process design based on failure diagnostics
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- Automotive special training
 - Dedicated automotive machines
 - Implementing screening
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- Considering the special control for automotive
ex : screening, yield monitoring
-

Our Automotive Quality grade

「Automotive quality guideline」

Quality grade		Class1	Class 2	Class3	Standard
Product	32kHz	—	○	○	○
	AT	—	○	○	○
	SAW	—	○	—	○
	Gyro	○	○	○	○
Design control		Automotive	Automotive	Standard	Standard
Process control		Automotive	Automotive	Individual support	Standard
Electrical inspection	High temp	Implement	Individual support	Individual support	Individual support
	Low temp	Implement	Individual support	Individual support	Individual support
Screening		Implement	Individual support	Individual support	N/A
Keep samples		15years	10years	N/A	N/A
Dedicated line		Dedicated	Dedicated	N/A	N/A

※Individual support : depending on products, specification

Size : 3.2mm × 2.5mm × 0.7mm Max. Ceramic Package

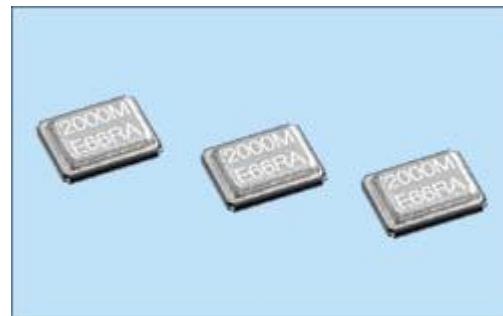
Terminal : 4pin

Frequency range : 12MHz ~ 60.000MHz

Operating temp range : -40°C ~ 125°C

Target Application : Car Multimedia, Body controls

Reliability : AEC-Q200 Compliant



● For automotive grade



● Lead Free compliant



● EU RoHS directive compliant

- Using the current design which we have volume business
- Using the current materials, process which we have volume business
 - Setting up the automotive grade MP line

1. High stability

- Characteristic at 25degree : $\pm 10\text{ppm}\sim$

2. Characteristic at operating temp

- $-40^{\circ}\text{C}\sim+125^{\circ}\text{C}$ (FTC : $\pm 50\text{ppm}\sim$)
- $+125^{\circ}\text{C}/1,000$ hours storage at high temperature
- $-40^{\circ}\text{C}(30\text{Minu})\leftrightarrow+125^{\circ}\text{C}(30\text{Minu}) / 1,000$ cycles

3. Reliability

- Compliance with AEC-Q200

1.Specification

No.	Item	Specification
1	Product name	FA-238A
2	Frequency range	12.000000MHz ~ 60.000000MHz
3	Drive mode	AT cut / Fundamental
4	Storage temperature range	-40°C ~ +125°C
5	Operating temperature range	-40°C ~ +125°C
6	Frequency stability(25±2°C)	+/-10.0 ppm ~
7	Stability at operating temperature	+/-50.0 ppm ~ (-40°C ~ +125°C) ※1
9	Equivalent series resistance(ESR)	See below table
10	Load capacitance	7.0 pF ~
11	Drive level	200 μW Max. (Recommendation : 1~100μW)
12	Aging	+/-1.0 ppm Max. / First year ※2
13	Dielectric resistance	More than 500 M Ω / DC 100V +/- 15V

※1 In case of out of our standard, please ask us

※2 Higher than 40MHz is 2ppm Max. / First year

Frequency range	ESR
12.0MHz ≤ f ≤ 13.0MHz	100Ω Max.
13.0MHz < f < 20.0MHz	80Ω Max.
20.0MHz ≤ f < 25.0MHz	60Ω Max.
25.0MHz ≤ f < 30.0MHz	50Ω Max.
30.0MHz ≤ f ≤ 60.0MHz	40Ω Max.

2.Dimension and footprint

	FA-238A	Remarks
Dimension	<p>Top view: 2000M e 66RA, width 3.2±0.1, height 2.5±0.1. Pin #1 and #2 are on the bottom edge, #3 and #4 are on the top edge.</p> <p>Side view: height 0.7 Max.</p> <p>Bottom view: pin #1 and #2 are 1.2 apart, pin #3 and #4 are 0.9 apart. Corner radius C 0.3Min. Pin #1 and #2 are 0.8 apart, #3 and #4 are 0.7 apart.</p> <p>Size in mm</p>	<p>Internal connection (TOP VIEW)</p> <p>※ #2, #4 are connected to cover (Connecting to GND)</p> <p>Material</p> <ul style="list-style-type: none"> •Lid / Kovar(Ni plating) •Base / Ceramic (W+Ni+Au) •Sealing / Seam weldong <p>Print</p> <ul style="list-style-type: none"> •Laser Marking
Footprint (Recommend)	<p>Dimensions: 2.2 (width between pads), 1.6 (height between pads), 1.2 (height of pads), 1.4 (width of pads).</p> <p>in mm</p>	-

1) Design change

- High temperature FA-238 Ag electrode → Au electrode
- F jump Adhesive change

2) Screening

- Detecting particle contamination (Drive Level Dependency inspection), hysteresis

3) Process control

- Monitoring special characteristic , Dedicated automotive line, Traceability

Comparison for specification of 3.2 × 2.5mm product

Product Item		FA-238V, FA-238	TSX-3225	FA-238A
Application		Clock for standard product	For wireless product	Clock for automotive
Frequency range		FA-238V: 12.0MHz~15.999MHz FA-238 : 16.0MHz~60.000MHz	16.000MHz~ 48.000MHz	12.0MHz~ 60.000MHz
Temperature	Storage	-40°C~+125°C		
	Operation			
Drive level		200μW Max.		
Frequency stability		±15ppm~	±10ppm~	±10ppm~
Stability at operating temperature		±30ppm~ (-20°C~+70°C)	±10ppm~ (-20°C~+75°C)	±50ppm~ (-40°C~+125°C)
Load capacitance		7pF~∞		
ESR	@12MHz	100Ω Max.	-	100Ω Max.
	@16MHz	80Ω Max.	60Ω Max.	80Ω Max.
	@48MHz	40Ω Max.	40Ω Max.	40Ω Max.
	@54MHz	40Ω Max.	-	40Ω Max.
Aging		±5ppm Max. / first year	±1ppm Max. / first year ※1	±1ppm Max. / first year ※1

※1 Higher frequency than 40MHz is ±2ppm Max. / first year

As we taking features of our released products, we develop FA-238A to fulfill high reliability and high temperature for automotive.

Products Comparison with competitors

Product Item		FA-238A	Part A	Part B	Part A	Part A
Maker		Seiko Epson	Company N		Company D	Company K
Application		Automotive	Automotive	Automotive	Automotive	Automotive
Dimension (Typ)		3.2 × 2.5 × 0.7	3.2 × 2.5 × 0.75	3.2 × 2.5 × 0.55	3.2 × 2.5 × 0.75	3.2 × 2.5 × 0.8
Terminal		4 Pin	4 Pin	4 Pin	4 Pin	4 Pin
Sealing		Seam	Glass	Seam	Glass	Glass
Frequency range		12.0MHz~60.0MHz	9.8MHz~50.0MHz	12.0MHz~50.0MHz	8.0MHz~40.0MHz	9.8MHz~54.0MHz
Temp Range	Storage	-40°C~+125°C	-40°C~+150°C	-40°C~+125°C	-40°C~+150°C	-40°C~+150°C
	Operation	-40°C~+125°C	-40°C~+150°C	-40°C~+125°C	-40°C~+150°C	-40°C~+150°C
Drive level		200μW Max.	200μW Max.	200μW Max.	200μW Max.	200μW Max.
Frequency stability		±10ppm~	±50ppm~	±15ppm~	±30ppm~	±50ppm~
Stability at temperature		±50ppm~ (-40°C~+125°C)	±150ppm~ (-40°C~+150°C)	±50ppm~ (-40°C~+125°C)	±200ppm~ (-40°C~+150°C)	±200ppm~ (-40°C~+150°C)
Equivalent Series Resistance	@9.8MHz	—	300Ω	—	200Ω	500Ω
	@12MHz	100Ω Max.	120Ω	120Ω	120Ω	300Ω
	@16MHz	80Ω Max.	120Ω	120Ω	120Ω	100Ω
	@48MHz	40Ω Max.	100Ω	100Ω	—	100Ω
	@54MHz	40Ω Max.	100Ω	—	—	100Ω

Compliant with AEC-Q200

AEC-Q200 RELIABILITY TEST ITEM
Product Name : FA-238A

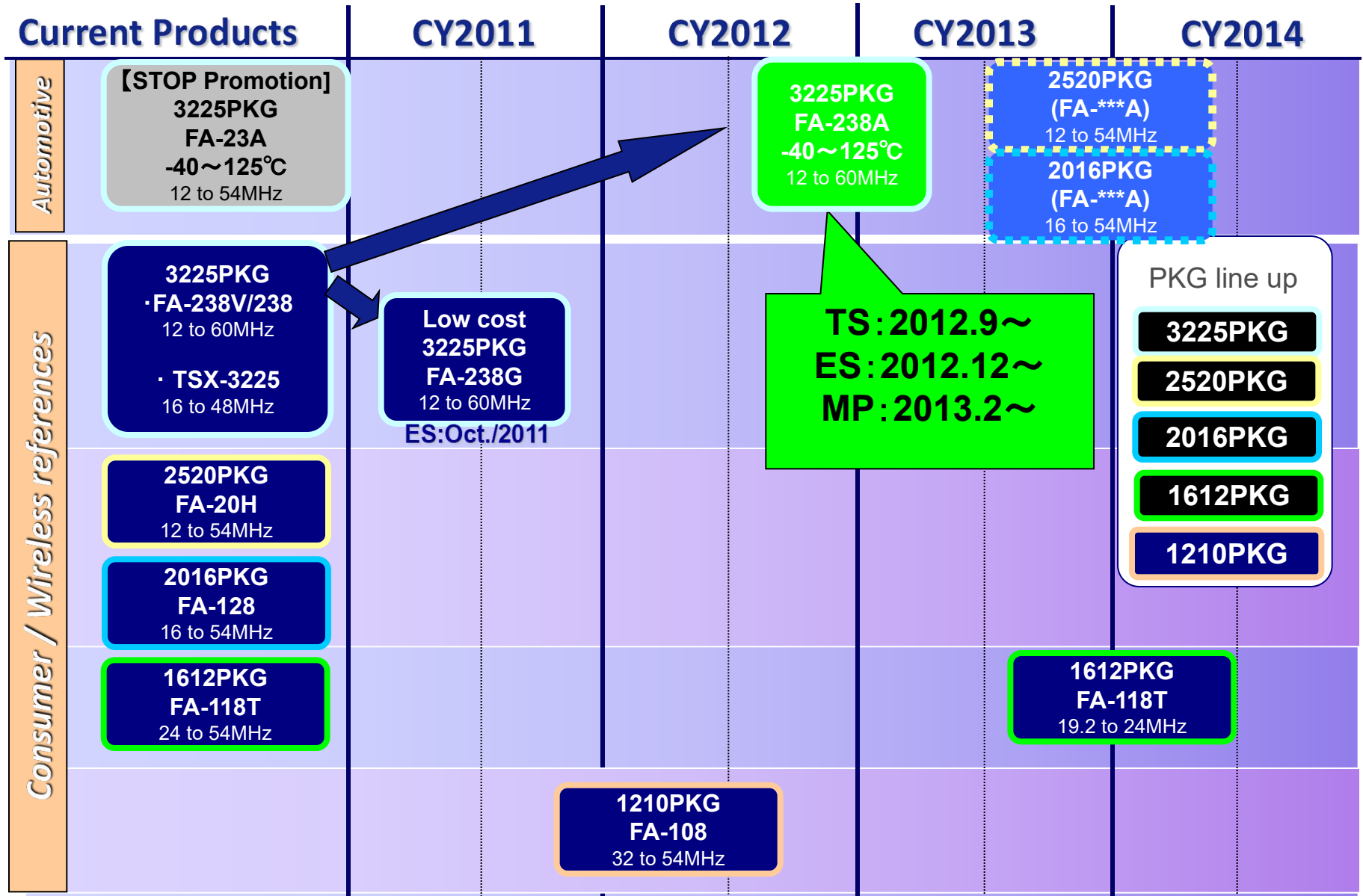
The Company evaluation condition
 We evaluate environmental and mechanical characteristics by the following test condition .

No.	ITEM	TEST CONDITIONS	TEST Qty [n]
3	High Temperature Exposure (Storage)	+125°C×1000hours	77
4	Temperrature Cycling	-40 °C ⇄ + 125 °C 30 min at each temp. 1000 cycles	77
6	Moisture Resistance	+25°C to +65°C, 80%RH to 98%RH, 10cycles (t=24hours/cycle)	77
7	Biased Humidity	+85 °C × 85 %RH ×3.6V× 1 000 hours	77
8	Operational Life	+125°C×3.6V×1000hours	77
9	External Visual	—	30
10	Physical Dimension	—	30
11	Terminal Strength	N/A	-
13	Mechanical Shock	100G×6m secods 6 directions×3 times	30
14	Vibration	10 to 40Hz, 1.5mm 40 to 2000Hz, 5g's 20minutes/cycles 12cycles × 3directions	30
15	Resistance to soldering heat	JEDEC-STD-020C 3time	30
16	Themal Shock	-55°C⇄+125°C 300cycles Dwell time:5 minutes.	30
18	Solderability	JESD22-B1002E	15
19	Electrical Characterization	Ta=+25°C	30×3lot
21	Board Flex	Bend width reaches 2mm and hold for 60s×1item	30
22	Terminal Strength	20N for 60 seconds.	30

- Notes
- Each test done independently.
 - Measuring 24 h later leaving in room temperature after each test.

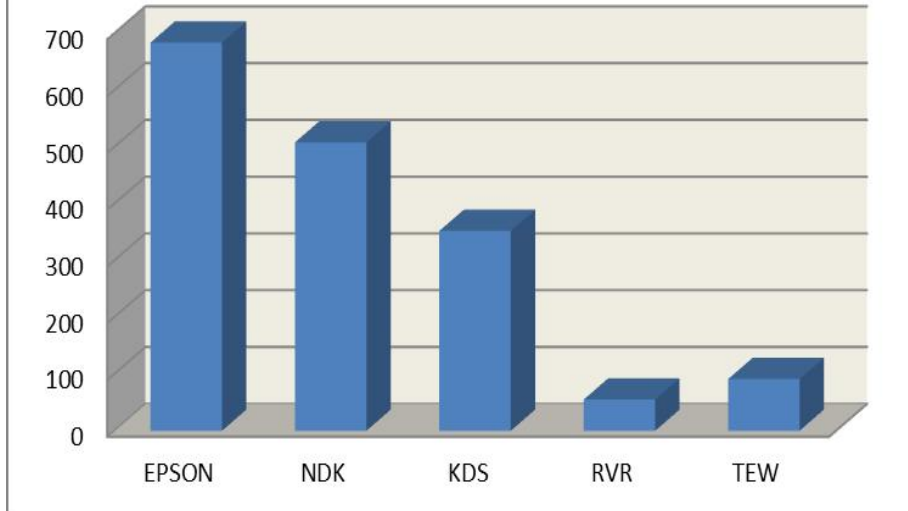
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AT Crystals Product Roadmap



【Sales amount】 and 【Production volume for smaller crystal than 3225】

FY 2011 sales amount

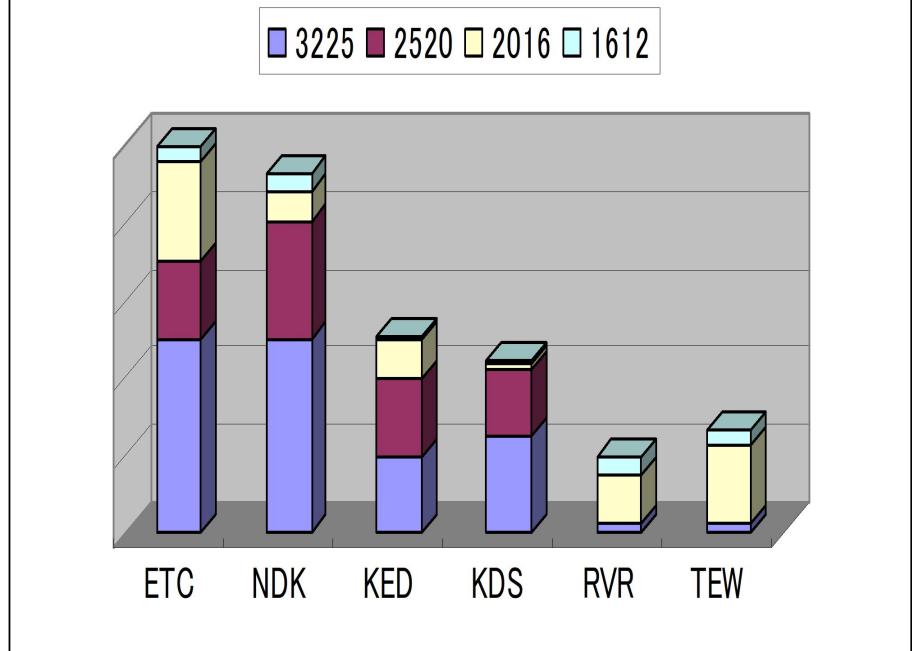


FY 2011 Sales amount

- EPSON : 68.4 Billion JPY
- NDK : 50.8 Billion JPY
- KDS : 35.2 Billion JPY
- RVR : 5.5 Billion JPY
- TEW : 9.1 Billion JPY

* KED : No official sales data for only quarts business

Smaller SMD type crystal production volume



Setting Epson as 100

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