

Ultra-small GRM series / GRM033 (0201 Chip size)

Features

1. Small chip size, 0201 (L: 0.6 x W: 0.3 x T: 0.3mm).
2. Temperature characteristics: C0G, U2J, X7R, X6S and X5R.
3. No polarity.
4. GRM033 series is suited to only reflow soldering.
5. GRM series is offered with a Ni barrier termination plated with Matte Tin (Sn), and is RoHS compliant.
6. Stringent dimensional tolerances allow highly reliable, high-speed automatic chip placement on PCBs.
7. GRM033 series is suited to miniature microwave module, portable equipment and high-frequency circuit.

Global Part Numbering

GR M 03 3 5C 1H R10 B D01 D
-1- -2- -3- -4- -5- -6- -7- -8- -9- -10-

-1-:Product ID

Code	Product
GR	MLCC

-2-:Series

Code	Product
M	Tin Plated Termination

-3-:Dimension (LxW)

Code	Dimension (LxW)
03	0.6x0.3mm (EIA:0201)

-4-:Dimension (T)

Code	Dimension (T)
3	0.3mm

-5-:Temperature Characteristics

Code	TC	Temp. Range	Cap. Change or Temp. Coefficient	Operating Temp.
5C	C0G	-55 to 125C	0+/-30ppm/C	-55 to 125C
7U	U2J	-55 to 85C	-750+/-120ppm/C	-55 to 125C
R7	X7R	-55 to 125C	+/-15%	-55 to 125C
C8	X6S	-55 to 105C	+/-22%	-55 to 105C
R6	X5R	-55 to 85C	+/-15%	-55 to 85C

-6-:Rated Voltage

Code	Rated Voltage
0E	DC2.5V
0G	DC 4V
0J	DC 6.3V
1A	DC 10V
1C	DC 16V
1E	DC 25V

-8-:Capacitance Tolerance

Code	Cap. Tol.	TC
B	+/-0.1pF	C0G,U2J(under 1pF)
C	+/-0.25pF	C0G,U2J(1 to 5pF)
D	+/-0.5pF	C0G,U2J(under 10pF)
J	+/-5%	C0G,U2J(10pF & over)
K	+/-10%	X7R, X6S, X5R
M	+/-20%	X7R, X6S, X5R

-7-:Capacitance

Code	Capacitance
R10	0.1pF
1R0	1pF
100	10pF
102	1,000pF
104	0.1uF

-9-:Individual Specification Code

-10-:Packaging

Code	Packaging
B	Bulk in nylon bag
D	Φ178mm Paper Taping

Ultra-small GRM series / GRM033 (0201 Chip size)

C0G (Temp. Code: 5C) : -55C to 125C, 0+/-30ppm/C

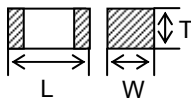
U2J (Temp. Code: 7U) : -55C to 85C, -750+/-120ppm/C (Operating Temp. : -55 to 125C)

X7R (Temp. Code: R7) : -55C to 125C, +/-15%

X6S (Temp. Code: C8) : -55C to 105C, +/-22%

X5R (Temp. Code: R6) : -55C to 85C, +/-15%

Chip dimension



EIA size	(in mm)		
	L	W	T
0201	0.6+/-0.03	0.3+/-0.03	0.3+/-0.03

Chip size and Capacitance range

Type (Size)	TC	WV	Capacitance Range							
			1pF	10pF	100pF	1000pF	0.01uF	0.1uF		
GRM033 (0201)	C0G	50	■	■	■	■	■	■	■	0.1 - 100pF
		50	■	■	■	■	■	■	■	0.5 - 15pF
	U2J	25	■	■	■	■	■	■	■	18 - 100pF
		25	■	■	■	■	■	■	■	100 - 1500pF
	X7R	16	■	■	■	■	■	■	■	2200 - 3300pF
		10	■	■	■	■	■	■	■	4700pF - 0.01uF
	X6S	6.3	■	■	■	■	■	■	■	0.015 - 0.047uF
		4	■	■	■	■	■	■	■	0.068uF - 0.1uF
		2.5	■	■	■	■	■	■	■	0.22uF
	X5R	6.3	■	■	■	■	■	■	■	0.015 - 0.1uF
4		■	■	■	■	■	■	■	0.22uF	

Ultra-small GRM series / GRM033 (0201 Chip size)

Murata P/N List < C0G >

Size	Chip T (mm)	TC	WV	Cap	Cap Tol	Murata Global P/N	Sample	M.P.
0201	0.3+/-0.03	C0G	50V	0.1pF	+/-0.1pF	GRM0335C1HR10BD01D	Available	Mass Production
	0.3+/-0.03	C0G		0.2pF	+/-0.1pF	GRM0335C1HR20BD01D	Available	Mass Production
	0.3+/-0.03	C0G		0.3pF	+/-0.1pF	GRM0335C1HR30BD01D	Available	Mass Production
	0.3+/-0.03	C0G		0.4pF	+/-0.1pF	GRM0335C1HR40BD01D	Available	Mass Production
	0.3+/-0.03	C0G		0.5pF	+/-0.1pF	GRM0335C1HR50BD01D	Available	Mass Production
	0.3+/-0.03	C0G		0.6pF	+/-0.1pF	GRM0335C1HR60BD01D	Available	Mass Production
	0.3+/-0.03	C0G		0.7pF	+/-0.1pF	GRM0335C1HR70BD01D	Available	Mass Production
	0.3+/-0.03	C0G		0.8pF	+/-0.1pF	GRM0335C1HR80BD01D	Available	Mass Production
	0.3+/-0.03	C0G		0.9pF	+/-0.1pF	GRM0335C1HR90BD01D	Available	Mass Production
	0.3+/-0.03	C0G		1pF	+/-0.25pF	GRM0335C1H1R0CD01D	Available	Mass Production
	0.3+/-0.03	C0G		1.2pF	+/-0.25pF	GRM0335C1H1R2CD01D	Available	Mass Production
	0.3+/-0.03	C0G		1.5pF	+/-0.25pF	GRM0335C1H1R5CD01D	Available	Mass Production
	0.3+/-0.03	C0G		1.8pF	+/-0.25pF	GRM0335C1H1R8CD01D	Available	Mass Production
	0.3+/-0.03	C0G		2pF	+/-0.25pF	GRM0335C1H2R0CD01D	Available	Mass Production
	0.3+/-0.03	C0G		2.2pF	+/-0.25pF	GRM0335C1H2R2CD01D	Available	Mass Production
	0.3+/-0.03	C0G		2.7pF	+/-0.25pF	GRM0335C1H2R7CD01D	Available	Mass Production
	0.3+/-0.03	C0G		3pF	+/-0.25pF	GRM0335C1H3R0CD01D	Available	Mass Production
	0.3+/-0.03	C0G		3.3pF	+/-0.25pF	GRM0335C1H3R3CD01D	Available	Mass Production
	0.3+/-0.03	C0G		3.9pF	+/-0.25pF	GRM0335C1H3R9CD01D	Available	Mass Production
	0.3+/-0.03	C0G		4pF	+/-0.25pF	GRM0335C1H4R0CD01D	Available	Mass Production
	0.3+/-0.03	C0G		4.7pF	+/-0.25pF	GRM0335C1H4R7CD01D	Available	Mass Production
	0.3+/-0.03	C0G		5pF	+/-0.25pF	GRM0335C1H5R0CD01D	Available	Mass Production
	0.3+/-0.03	C0G		5.6pF	+/-0.5pF	GRM0335C1H5R6DD01D	Available	Mass Production
	0.3+/-0.03	C0G		6pF	+/-0.5pF	GRM0335C1H6R0DD01D	Available	Mass Production
	0.3+/-0.03	C0G		6.8pF	+/-0.5pF	GRM0335C1H6R8DD01D	Available	Mass Production
	0.3+/-0.03	C0G		7pF	+/-0.5pF	GRM0335C1H7R0DD01D	Available	Mass Production
	0.3+/-0.03	C0G		8pF	+/-0.5pF	GRM0335C1H8R0DD01D	Available	Mass Production
	0.3+/-0.03	C0G		8.2pF	+/-0.5pF	GRM0335C1H8R2DD01D	Available	Mass Production
	0.3+/-0.03	C0G		9pF	+/-0.5pF	GRM0335C1H9R0DD01D	Available	Mass Production
	0.3+/-0.03	C0G		10pF	+/-5%	GRM0335C1H100JD01D	Available	Mass Production
	0.3+/-0.03	C0G		12pF	+/-5%	GRM0335C1H120JD01D	Available	Mass Production
	0.3+/-0.03	C0G		15pF	+/-5%	GRM0335C1H150JD01D	Available	Mass Production
	0.3+/-0.03	C0G		18pF	+/-5%	GRM0335C1H180JD01D	Available	Mass Production
	0.3+/-0.03	C0G		22pF	+/-5%	GRM0335C1H220JD01D	Available	Mass Production
	0.3+/-0.03	C0G		27pF	+/-5%	GRM0335C1H270JD01D	Available	Mass Production
	0.3+/-0.03	C0G		33pF	+/-5%	GRM0335C1H330JD01D	Available	Mass Production
0.3+/-0.03	C0G	39pF	+/-5%	GRM0335C1H390JD01D	Available	Mass Production		
0.3+/-0.03	C0G	47pF	+/-5%	GRM0335C1H470JD01D	Available	Mass Production		
0.3+/-0.03	C0G	56pF	+/-5%	GRM0335C1H560JD01D	Available	Mass Production		
0.3+/-0.03	C0G	68pF	+/-5%	GRM0335C1H680JD01D	Available	Mass Production		
0.3+/-0.03	C0G	82pF	+/-5%	GRM0335C1H820JD01D	Available	Mass Production		
0.3+/-0.03	C0G	100pF	+/-5%	GRM0335C1H101JD01D	Available	Mass Production		

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2) Q1 = January to March, Q2 = April to June, Q3 = July to September, Q4 = October to December

3) This is muRata's development schedule, which may change due to progress of each development works.

4) Above individual specification code and packaging code were decided with muRata standard specification, and it may change due to the special requirement by customer's drawing.

Ultra-small GRM series / GRM033 (0201 Chip size)

Murata P/N List < C0G >

Size	Chip T (mm)	TC	WV	Cap	Cap Tol	Murata Global P/N	Sample	M.P.
0201	0.3+/-0.03	C0G	25V	0.1pF	+/-0.1pF	GRM0335C1ER10BZ01D	Available	Mass Production
	0.3+/-0.03	C0G		0.2pF	+/-0.1pF	GRM0335C1ER20BZ01D	Available	Mass Production
	0.3+/-0.03	C0G		0.3pF	+/-0.1pF	GRM0335C1ER30BZ01D	Available	Mass Production
	0.3+/-0.03	C0G		0.4pF	+/-0.1pF	GRM0335C1ER40BZ01D	Available	Mass Production
	0.3+/-0.03	C0G		0.5pF	+/-0.1pF	GRM0335C1ER50BZ01D	Available	Mass Production
	0.3+/-0.03	C0G		0.6pF	+/-0.1pF	GRM0335C1ER60BZ01D	Available	Mass Production
	0.3+/-0.03	C0G		0.7pF	+/-0.1pF	GRM0335C1ER70BZ01D	Available	Mass Production
	0.3+/-0.03	C0G		0.8pF	+/-0.1pF	GRM0335C1ER80BZ01D	Available	Mass Production
	0.3+/-0.03	C0G		0.9pF	+/-0.1pF	GRM0335C1ER90BZ01D	Available	Mass Production
	0.3+/-0.03	C0G		1pF	+/-0.25pF	GRM0335C1E1R0CD01D	Available	Mass Production
	0.3+/-0.03	C0G		1.2pF	+/-0.25pF	GRM0335C1E1R2CD01D	Available	Mass Production
	0.3+/-0.03	C0G		1.5pF	+/-0.25pF	GRM0335C1E1R5CD01D	Available	Mass Production
	0.3+/-0.03	C0G		1.8pF	+/-0.25pF	GRM0335C1E1R8CD01D	Available	Mass Production
	0.3+/-0.03	C0G		2pF	+/-0.25pF	GRM0335C1E2R0CD01D	Available	Mass Production
	0.3+/-0.03	C0G		2.2pF	+/-0.25pF	GRM0335C1E2R2CD01D	Available	Mass Production
	0.3+/-0.03	C0G		2.7pF	+/-0.25pF	GRM0335C1E2R7CD01D	Available	Mass Production
	0.3+/-0.03	C0G		3pF	+/-0.25pF	GRM0335C1E3R0CD01D	Available	Mass Production
	0.3+/-0.03	C0G		3.3pF	+/-0.25pF	GRM0335C1E3R3CD01D	Available	Mass Production
	0.3+/-0.03	C0G		3.9pF	+/-0.25pF	GRM0335C1E3R9CD01D	Available	Mass Production
	0.3+/-0.03	C0G		4pF	+/-0.25pF	GRM0335C1E4R0CD01D	Available	Mass Production
	0.3+/-0.03	C0G		4.7pF	+/-0.25pF	GRM0335C1E4R7CD01D	Available	Mass Production
	0.3+/-0.03	C0G		5pF	+/-0.25pF	GRM0335C1E5R0CD01D	Available	Mass Production
	0.3+/-0.03	C0G		5.6pF	+/-0.5pF	GRM0335C1E5R6DD01D	Available	Mass Production
	0.3+/-0.03	C0G		6pF	+/-0.5pF	GRM0335C1E6R0DD01D	Available	Mass Production
	0.3+/-0.03	C0G		6.8pF	+/-0.5pF	GRM0335C1E6R8DD01D	Available	Mass Production
	0.3+/-0.03	C0G		7pF	+/-0.5pF	GRM0335C1E7R0DD01D	Available	Mass Production
	0.3+/-0.03	C0G		8pF	+/-0.5pF	GRM0335C1E8R0DD01D	Available	Mass Production
	0.3+/-0.03	C0G		8.2pF	+/-0.5pF	GRM0335C1E8R2DD01D	Available	Mass Production
	0.3+/-0.03	C0G		9pF	+/-0.5pF	GRM0335C1E9R0DD01D	Available	Mass Production
	0.3+/-0.03	C0G		10pF	+/-5%	GRM0335C1E100JD01D	Available	Mass Production
	0.3+/-0.03	C0G		12pF	+/-5%	GRM0335C1E120JD01D	Available	Mass Production
	0.3+/-0.03	C0G		15pF	+/-5%	GRM0335C1E150JD01D	Available	Mass Production
	0.3+/-0.03	C0G		18pF	+/-5%	GRM0335C1E180JD01D	Available	Mass Production
	0.3+/-0.03	C0G		22pF	+/-5%	GRM0335C1E220JD01D	Available	Mass Production
	0.3+/-0.03	C0G		27pF	+/-5%	GRM0335C1E270JD01D	Available	Mass Production
	0.3+/-0.03	C0G		33pF	+/-5%	GRM0335C1E330JD01D	Available	Mass Production
	0.3+/-0.03	C0G		39pF	+/-5%	GRM0335C1E390JD01D	Available	Mass Production
	0.3+/-0.03	C0G		47pF	+/-5%	GRM0335C1E470JD01D	Available	Mass Production
	0.3+/-0.03	C0G		56pF	+/-5%	GRM0335C1E560JD01D	Available	Mass Production
	0.3+/-0.03	C0G		68pF	+/-5%	GRM0335C1E680JD01D	Available	Mass Production
0.3+/-0.03	C0G	82pF	+/-5%	GRM0335C1E820JD01D	Available	Mass Production		
0.3+/-0.03	C0G	100pF	+/-5%	GRM0335C1E101JD01D	Available	Mass Production		

1) “*” of under development P/N have not fixed yet.

2) Q1 = January to March, Q2 = April to June, Q3 = July to September, Q4 = October to December

3) This is muRata’s development schedule, which may change due to progress of each development works.

4) Above individual specification code and packaging code were decided with muRata standard specification, and it may change due to the special requirement by customer’s drawing.

Ultra-small GRM series / GRM033 (0201 Chip size)

Murata P/N List < U2J >

Size	Chip T (mm)	TC	VV	Cap	Cap Tol	Murata Global P/N	Sample	M.P.
0201	0.3+/-0.03	U2J	50V	0.5pF	+/-0.1pF	GRM0337U1HR50BD01D	Available	Mass Production
	0.3+/-0.03	U2J		0.6pF	+/-0.1pF	GRM0337U1HR60BD01D	Available	Mass Production
	0.3+/-0.03	U2J		0.7pF	+/-0.1pF	GRM0337U1HR70BD01D	Available	Mass Production
	0.3+/-0.03	U2J		0.8pF	+/-0.1pF	GRM0337U1HR80BD01D	Available	Mass Production
	0.3+/-0.03	U2J		0.9pF	+/-0.1pF	GRM0337U1HR90BD01D	Available	Mass Production
	0.3+/-0.03	U2J		1pF	+/-0.25pF	GRM0337U1H1R0CD01D	Available	Mass Production
	0.3+/-0.03	U2J		1.2pF	+/-0.25pF	GRM0337U1H1R2CD01D	Available	Mass Production
	0.3+/-0.03	U2J		1.5pF	+/-0.25pF	GRM0337U1H1R5CD01D	Available	Mass Production
	0.3+/-0.03	U2J		1.8pF	+/-0.25pF	GRM0337U1H1R8CD01D	Available	Mass Production
	0.3+/-0.03	U2J		2pF	+/-0.25pF	GRM0337U1H2R0CD01D	Available	Mass Production
	0.3+/-0.03	U2J		2.2pF	+/-0.25pF	GRM0337U1H2R2CD01D	Available	Mass Production
	0.3+/-0.03	U2J		2.7pF	+/-0.25pF	GRM0337U1H2R7CD01D	Available	Mass Production
	0.3+/-0.03	U2J		3pF	+/-0.25pF	GRM0337U1H3R0CD01D	Available	Mass Production
	0.3+/-0.03	U2J		3.3pF	+/-0.25pF	GRM0337U1H3R3CD01D	Available	Mass Production
	0.3+/-0.03	U2J		3.9pF	+/-0.25pF	GRM0337U1H3R9CD01D	Available	Mass Production
	0.3+/-0.03	U2J		4pF	+/-0.25pF	GRM0337U1H4R0CD01D	Available	Mass Production
	0.3+/-0.03	U2J		4.7pF	+/-0.25pF	GRM0337U1H4R7CD01D	Available	Mass Production
	0.3+/-0.03	U2J		5pF	+/-0.25pF	GRM0337U1H5R0CD01D	Available	Mass Production
	0.3+/-0.03	U2J		5.6pF	+/-0.5pF	GRM0337U1H5R6DD01D	Available	Mass Production
	0.3+/-0.03	U2J		6pF	+/-0.5pF	GRM0337U1H6R0DD01D	Available	Mass Production
	0.3+/-0.03	U2J		6.8pF	+/-0.5pF	GRM0337U1H6R8DD01D	Available	Mass Production
	0.3+/-0.03	U2J		7pF	+/-0.5pF	GRM0337U1H7R0DD01D	Available	Mass Production
	0.3+/-0.03	U2J		8pF	+/-0.5pF	GRM0337U1H8R0DD01D	Available	Mass Production
	0.3+/-0.03	U2J		8.2pF	+/-0.5pF	GRM0337U1H8R2DD01D	Available	Mass Production
	0.3+/-0.03	U2J	9pF	+/-0.5pF	GRM0337U1H9R0DD01D	Available	Mass Production	
	0.3+/-0.03	U2J	10pF	+/-5%	GRM0337U1H100JD01D	Available	Mass Production	
	0.3+/-0.03	U2J	12pF	+/-5%	GRM0337U1H120JD01D	Available	Mass Production	
	0.3+/-0.03	U2J	15pF	+/-5%	GRM0337U1H150JD01D	Available	Mass Production	
	0.3+/-0.03	U2J	25V	18pF	+/-5%	GRM0337U1E180JD01D	Available	Mass Production
	0.3+/-0.03	U2J		22pF	+/-5%	GRM0337U1E220JD01D	Available	Mass Production
	0.3+/-0.03	U2J		27pF	+/-5%	GRM0337U1E270JD01D	Available	Mass Production
	0.3+/-0.03	U2J		33pF	+/-5%	GRM0337U1E330JD01D	Available	Mass Production
	0.3+/-0.03	U2J		39pF	+/-5%	GRM0337U1E390JD01D	Available	Mass Production
0.3+/-0.03	U2J	47pF		+/-5%	GRM0337U1E470JD01D	Available	Mass Production	
0.3+/-0.03	U2J	56pF		+/-5%	GRM0337U1E560JD01D	Available	Mass Production	
0.3+/-0.03	U2J	68pF		+/-5%	GRM0337U1E680JD01D	Available	Mass Production	
0.3+/-0.03	U2J	82pF		+/-5%	GRM0337U1E820JD01D	Available	Mass Production	
0.3+/-0.03	U2J	100pF	+/-5%	GRM0337U1E101JD01D	Available	Mass Production		

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Ultra-small GRM series / GRM033 (0201 Chip size)

Murata P/N List < X7R >

Size	Chip T (mm)	TC	WV	Cap	Cap Tol	Murata Global P/N	Sample	M.P.
0201	0.3+/-0.03	X7R	25V	100pF	+/-10%	GRM033R71E101KA01D	Available	Mass Production
	0.3+/-0.03	X7R		150pF	+/-10%	GRM033R71E151KA01D	Available	Mass Production
	0.3+/-0.03	X7R		220pF	+/-10%	GRM033R71E221KA01D	Available	Mass Production
	0.3+/-0.03	X7R		330pF	+/-10%	GRM033R71E331KA01D	Available	Mass Production
	0.3+/-0.03	X7R		470pF	+/-10%	GRM033R71E471KA01D	Available	Mass Production
	0.3+/-0.03	X7R		680pF	+/-10%	GRM033R71E681KA01D	Available	Mass Production
	0.3+/-0.03	X7R		1,000pF	+/-10%	GRM033R71E102KA01D	Available	Mass Production
	0.3+/-0.03	X7R	16V	1,500pF	+/-10%	GRM033R71E152KA01D	Available	Mass Production
	0.3+/-0.03	X7R		2,200pF	+/-10%	GRM033R71C222KA88D	Available	Mass Production
	0.3+/-0.03	X7R		3,300pF	+/-10%	GRM033R71C332KA88D	Available	Mass Production
	0.3+/-0.03	X7R	10V	4,700pF	+/-10%	GRM033R71A472KA01D	Available	Mass Production
	0.3+/-0.03	X7R		6,800pF	+/-10%	GRM033R71A682KA01D	Available	Mass Production
	0.3+/-0.03	X7R		0.01uF	+/-10%	GRM033R71A103KA01D	Available	Mass Production

Murata P/N List < X6S >

Size	Chip T (mm)	TC	WV	Cap	Cap Tol	Murata Global P/N	Sample	M.P.
0201	0.3+/-0.03	X6S	6.3V	0.015uF	+/-10%	GRM033C80J153KE01D	Available	Mass Production
	0.3+/-0.03	X6S		0.022uF	+/-10%	GRM033C80J223KE01D	Available	Mass Production
	0.3+/-0.03	X6S		0.033uF	+/-10%	GRM033C80J333KE01D	Available	Mass Production
	0.3+/-0.03	X6S	4V	0.047uF	+/-10%	GRM033C80J473KE19D	Available	Mass Production
	0.3+/-0.03	X6S		0.068uF	+/-10%	GRM033C80G683KE19D	Available	Mass Production
	0.3+/-0.03	X6S		0.1uF	+/-10%	GRM033C80G104KE19D	Available	Mass Production
	0.3+/-0.03	X6S		2.5V	0.22uF	+/-20%	GRM033C80E224ME15D	Available

Murata P/N List < X5R >

Size	Chip T (mm)	TC	WV	Cap	Cap Tol	Murata Global P/N	Sample	M.P.
0201	0.3+/-0.03	X5R	6.3V	0.015uF	+/-10%	GRM033R60J153KE01D	Available	Mass Production
	0.3+/-0.03	X5R		0.022uF	+/-10%	GRM033R60J223KE01D	Available	Mass Production
	0.3+/-0.03	X5R		0.033uF	+/-10%	GRM033R60J333KE01D	Available	Mass Production
	0.3+/-0.03	X5R		0.047uF	+/-10%	GRM033R60J473KE19D	Available	Mass Production
	0.3+/-0.03	X5R		0.068uF	+/-10%	GRM033R60J683KE19D	Available	Mass Production
	0.3+/-0.03	X5R		0.1uF	+/-10%	GRM033R60J104KE19D	Available	Mass Production
	0.3+/-0.03	X5R	4V	0.22uF	+/-20%	GRM033R60G224ME15D	Available	Mass Production

1) "*" of under development P/N have not fixed yet.

2) Q1 = January to March, Q2 = April to June, Q3 = July to September, Q4 = October to December

3) This is muRata's development schedule, which may change due to progress of each development works.

4) Above individual specification code and packaging code were decided with muRata standard specification, and it may change due to the special requirement by customer's drawing.