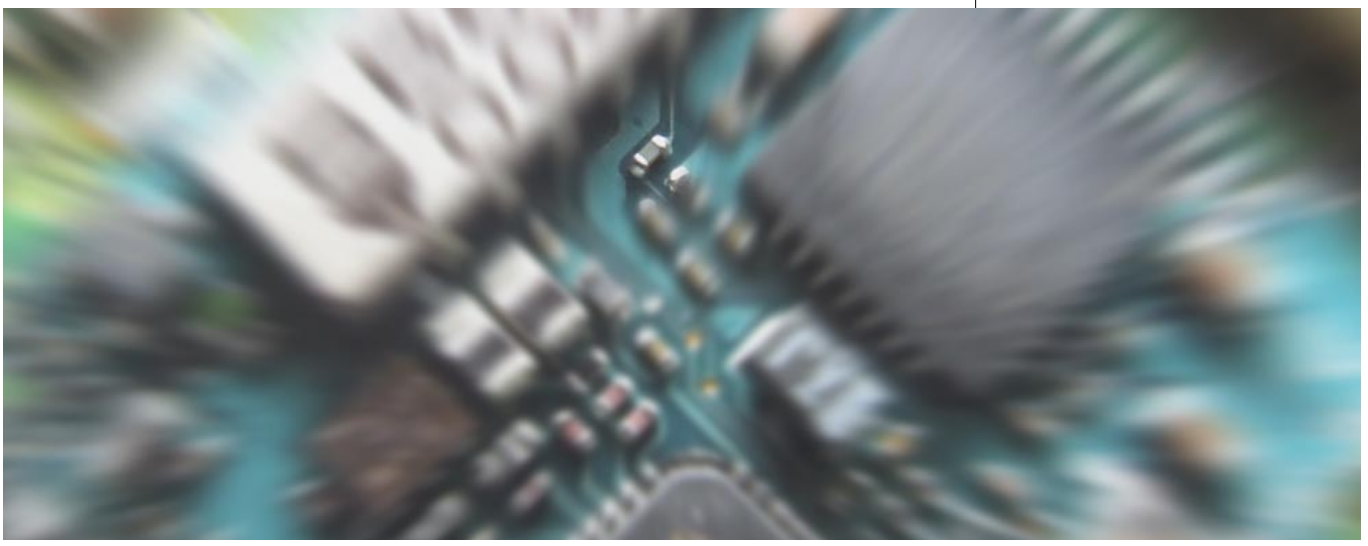
Multilayer Chip Inductors For High-frequency Circuits And Modules

MLK Series 0603 Type

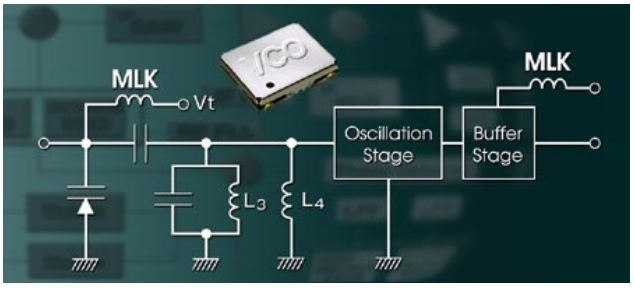
Conforming to RoHS Directive

Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.



Development concept/Features and advantages

Type 0603 is the smallest in the MLK series, which has extensively been used as the optimal high Q element for processing the 1-2 GHz signals of mobile communication devices.



With further fine-tuned super-fine multilayer technology, allowing no misalignment — even of submicron-order, mass-production technology of condensed "GIGASPIRA multilayer structure", of greater precision than ever, inside the super-small 0603 chip where the area of internal conductor pattern can be reduced to 1/3 of the 1005 type, has been established.

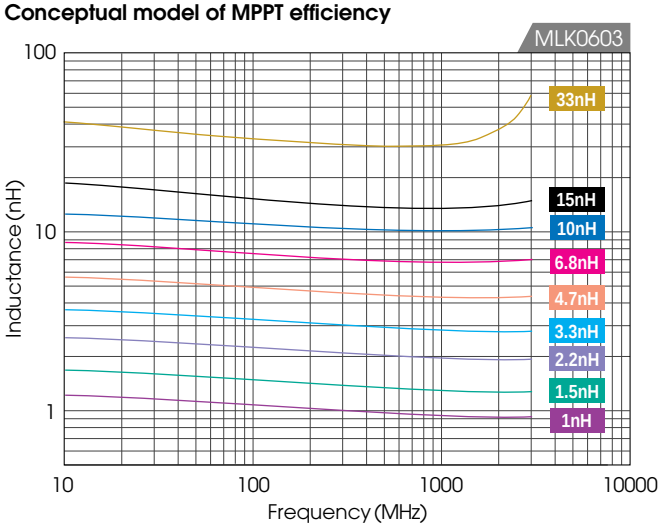
The product line of 31 types carefully covers 1-33nH, responding to the needs of the latest designs of small digital devices with optimal specifications.

Original GHz-band-ready structure overcoming the limitations of the conventional multilayer structures.

The Q characteristics, which was upgraded to support GHz bands, reached the whole new level with the TDK-EPC's original GIGASPIRA multilayer structure in which the internal conductors are formed spirally in the longer direction of the chip.

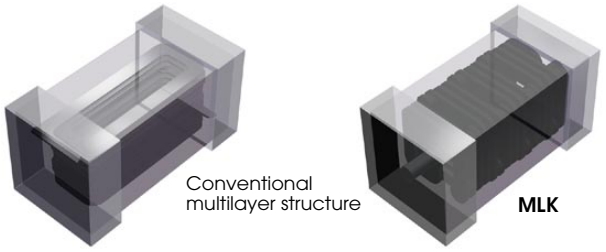
Because the distance available for conductor layers can be about twice longer than that of the chip induc-

Conceptual model of MPPT efficiency



MLK Series 0603 Type

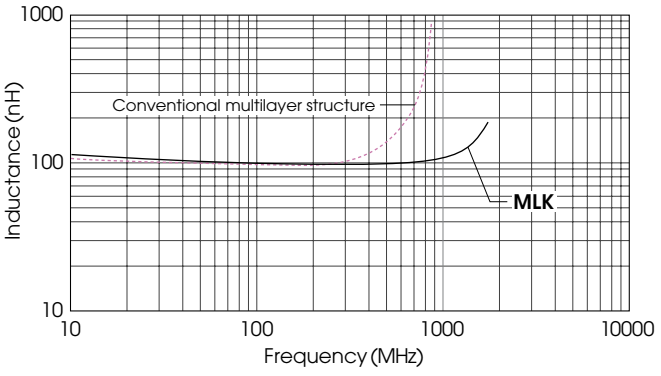
tors of the conventional multilayer structures where spiral conductors were formed in the thickness direction, this type allows multilayering and high inductance of the internal conductors which exceed the winding count of the conventional structures while the distance between each end face of internal conductors (start and end layers of the winding) and the terminal electrodes, and the distance between the layers of internal conductors are made as long as possible.



Structural advantages for GHz bands

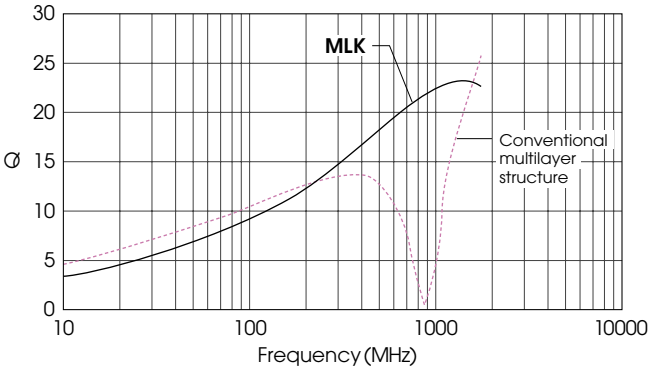
The dimension of the side of the internal conductor becomes greater if low-Rdc and high inductance are sought within the conventional internal conductor multilayer structure. The distance between the sides of internal conductor and terminal electrode also tends to be shorter as the chip is downsized, which causes an increase of stray capacitance.

Inductance vs. frequency characteristics
Comparative example of Type 1005, 100nH product

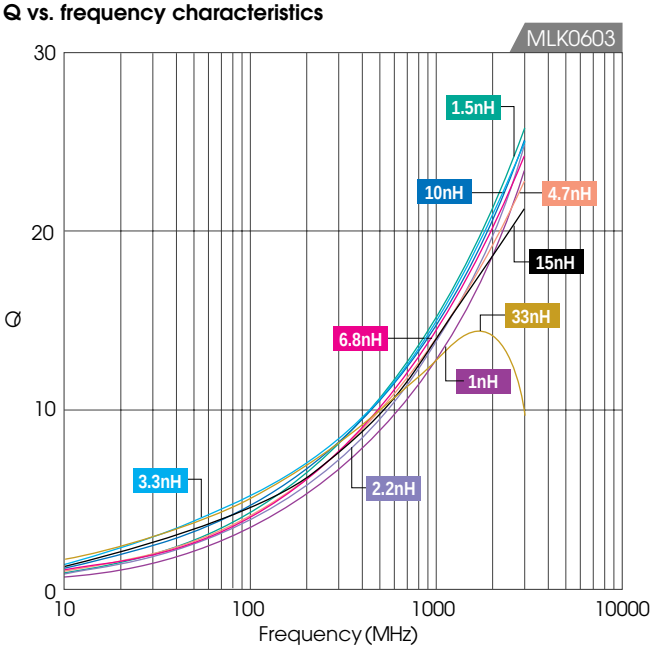


On the other hand, the GIGASPIRA multilayer structure connects the first conductor layer with terminal electrode through a via-hole conductor. By optimizing the thickness (length) of the via-hole conductor, the stray capacitance between the internal conductor and terminal electrode can be smaller, which means that LC resonance frequency can be shifted to higher frequencies. This allows unprecedented self-resonant frequency bands of 2GHz (100nH product) - 19GHz (1nH product), outdoing the chip inductors of conventional multilayer structures. The best and strongest high Q char-acteristics (20-32 at 1GHz) for GHz-band signal processing circuits, which determine the basic performance and speech quality of mobile phone devices, were achieved.

Q vs. frequency characteristics
Comparative example of Type 1005, 100nH product



Q vs. frequency characteristics

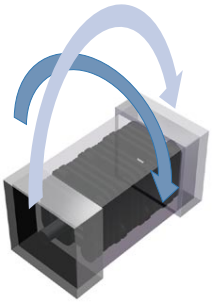


One additional advantage — fully compliant with bulk attachment

With altered multilayer direction of internal conductors, and both ends of the conductors being placed in the center of an element's longitudinal direction, and via hole conductors connecting them with the center of terminal electrodes, MLK has achieved electrical symmetry that can maintain balance of its characteristic, whether it revolves in any direction. For the first time, bulk attachment is fully compliant as a high-frequency

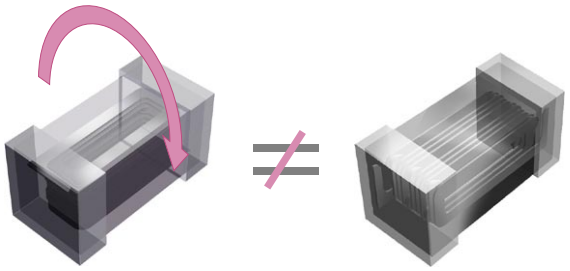
Basic specifications / Electrical characteristics

chip inductor where high characteristic stability is required, such as matching circuits.



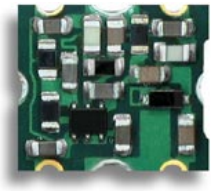
Fully compliant with bulk attachment

The conventional structure altered the relative position of the internally-connected conductors and land patterns as the element revolved, the inductance value showed a minor fluctuation. However, when it's used for matching of GHz-band signal circuits, this small fluctuation can't be ignored and attachment by the directional identification marking was necessary.

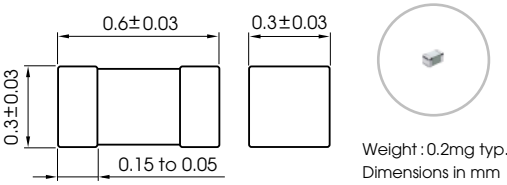


Conventional multilayer structure

In addition to the circuit condensation effect after minimization of the chips and the improvement in signal quality using high-Q, MLK can provide more effective benefits than those of conventional elements, such as stable design of circuit characteristic, stabilized quality, improved implementation cost, and so forth.

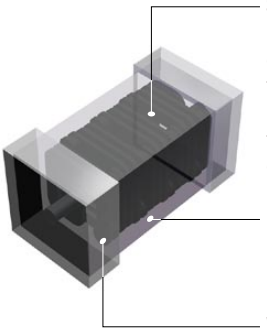


Shapes and dimensions



Weight : 0.2mg typ.
Dimensions in mm

Internal structure model

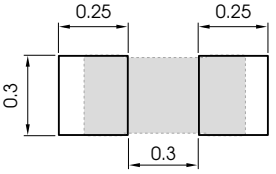


Sophisticated low-resistant Ag internal conductors condensed in the original GIGASPIRA multilayer structure.
Realized through the mass production line management technology of submicron order

Low-dielectric micro ceramic material for which reduced stray capacitance was sought.

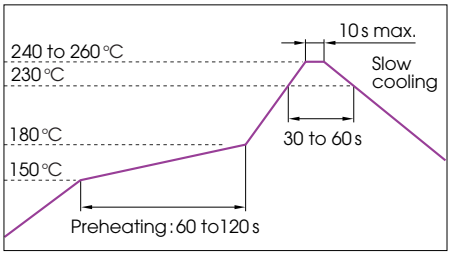
With Ni + high-purity Sn-plated processed electrodes, the product complies with lead-free soldering and high-temperature reflow processes.

Recommended PC board pattern
(Reflow process)



Dimensions in mm

Recommended soldering conditions
Lead-free solder/High-temperature reflow process



Environmental characteristics

Operating temperature range : −55 to +125℃
Storage temperature rangee : −55 to +125℃

Multilayer Chip Inductors
For High-frequency Circuits And Modules

MLK Series 0603 Type

Example of electrical characteristics

Part No.	Inductance (nH)	Inductance tolerance (%)	Q min.	Inductance, Q test frequency (MHz)	Self-resonance frequency (GHz)		DC resistance (Ω)		Rated current (mA) max.
					min.	typ.	max.	typ.	
MLK0603L1N0ST	1.0	±0.3nH	4	100	12	17.1	0.2	0.09	300
MLK0603L1N1ST	1.1	±0.3nH	4	100	11	17.1	0.22	0.1	300
MLK0603L1N2ST	1.2	±0.3nH	4	100	11	16.1	0.22	0.11	300
MLK0603L1N3ST	1.3	±0.3nH	5	100	10	15.8	0.24	0.11	300
MLK0603L1N5ST	1.5	±0.3nH	4	100	10	14.9	0.24	0.12	300
MLK0603L1N6ST	1.6	±0.3nH	5	100	10	14.4	0.27	0.13	300
MLK0603L1N8ST	1.8	±0.3nH	4	100	10	13.8	0.27	0.14	300
MLK0603L2N0ST	2.0	±0.3nH	5	100	9	12.7	0.3	0.14	300
MLK0603L2N2ST	2.2	±0.3nH	5	100	9	12.5	0.3	0.17	300
MLK0603L2N4ST	2.4	±0.3nH	5	100	8.5	11.5	0.35	0.17	300
MLK0603L2N7ST	2.7	±0.3nH	5	100	8.5	10.9	0.35	0.18	300
MLK0603L3N0ST	3.0	±0.3nH	5	100	8	10.7	0.4	0.2	200
MLK0603L3N3ST	3.3	±0.3nH	5	100	8	10.5	0.4	0.22	200
MLK0603L3N6ST	3.6	±0.3nH	5	100	8	10	0.45	0.21	200
MLK0603L3N9ST	3.9	±0.3nH	5	100	8	9.8	0.45	0.25	200
MLK0603L4N3ST	4.3	±0.3nH	5	100	7.5	9.5	0.5	0.27	200
MLK0603L4N7ST	4.7	±0.3nH	5	100	7.5	9.5	0.5	0.28	200
MLK0603L5N1ST	5.1	±0.3nH	5	100	6.5	8.9	0.6	0.28	200
MLK0603L5N6ST	5.6	±0.3nH	5	100	6.5	8.5	0.6	0.3	200
MLK0603L6N2ST	6.2	±0.3nH	5	100	6	8.3	0.65	0.33	200
MLK0603L6N8JT	6.8	±5%	5	100	6	8.1	0.65	0.34	200
MLK0603L7N5JT	7.5	±5%	5	100	6	7.8	0.7	0.36	200
MLK0603L8N2JT	8.2	±5%	5	100	6	7.9	0.7	0.41	200
MLK0603L9N1JT	9.1	±5%	5	100	5.5	7.5	0.8	0.41	200
MLK0603L10NJT	10	±5%	5	100	5.5	7.5	0.8	0.48	200
MLK0603L12NJT	12	±5%	5	100	5	6.9	1	0.54	150
MLK0603L15NJT	15	±5%	5	100	4.5	6.6	1.1	0.66	150
MLK0603L18NJT	18	±5%	5	100	4	5.8	1.3	0.85	100
MLK0603L22NJT	22	±5%	5	100	3.5	5.3	1.6	1.02	100
MLK0603L27NJT	27	±5%	5	100	3	4.6	1.7	1.09	100
MLK0603L33NJT	33	±5%	5	100	2.8	4.4	1.8	1.21	100

Inductance, Q: HP4291A Impedance/gain-phase analyzer or equivalents / 16193A Test fixture or equivalents
Self-resonance frequency : HP8720C Network analyzer or equivalents
DC resistance : YOKOGAWA TYPE7561 or equivalents
Rated current : The value where the temperature of the inductor increases by 20°C is applied.

Frequency characteristics / Example of application

Frequency characteristics / Example of application

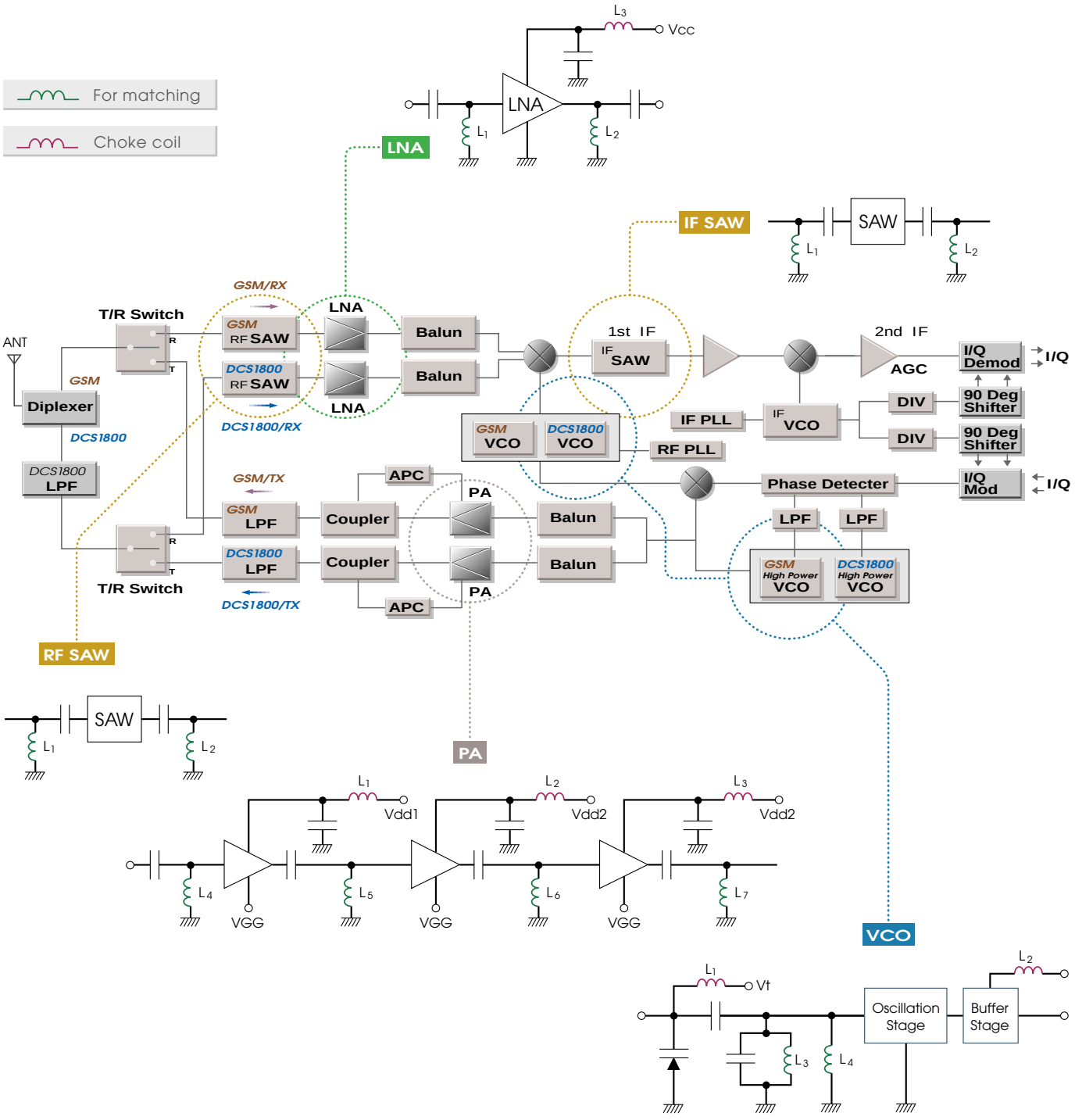
Part No.	Inductance(nH) typ. 500MHz	800MHz	1.8GH	2GH	2.4GHz	Q typ. 500MHz	800MHz	1.8GH	2GH	2.4GHz
MLK0603L1N0ST	0.9	0.9	0.9	0.9	0.9	10	12	19	20	22
MLK0603L1N1ST	1	1	0.9	0.9	0.9	9	11	17	18	20
MLK0603L1N2ST	1.1	1	1	1	1	9	12	18	19	21
MLK0603L1N3ST	1.2	1.1	1.1	1.1	1.1	9	12	18	19	21
MLK0603L1N5ST	1.3	1.3	1.3	1.3	1.3	9	12	18	19	21
MLK0603L1N6ST	1.4	1.4	1.4	1.4	1.4	9	12	18	19	21
MLK0603L1N8ST	1.6	1.6	1.6	1.6	1.6	9	11	17	18	20
MLK0603L2N0ST	1.8	1.7	1.7	1.7	1.7	9	12	17	18	20
MLK0603L2N2ST	2	1.9	1.9	1.9	2	10	12	19	20	22
MLK0603L2N4ST	2.1	2.1	2.1	2.1	2.1	9	12	18	19	20
MLK0603L2N7ST	2.4	2.4	2.4	2.4	2.4	10	13	19	20	22
MLK0603L3N0ST	2.7	2.6	2.6	2.6	2.7	9	12	18	19	21
MLK0603L3N3ST	3	2.9	2.9	3	3	10	13	19	20	22
MLK0603L3N6ST	3.2	3.1	3.1	3.1	3.2	9	11	17	18	19
MLK0603L3N9ST	3.5	3.4	3.5	3.5	3.5	10	13	19	20	22
MLK0603L4N3ST	3.8	3.8	3.8	3.8	3.9	10	12	18	19	20
MLK0603L4N7ST	4.2	4.2	4.2	4.2	4.3	10	13	19	20	22
MLK0603L5N1ST	4.6	4.5	4.5	4.6	4.7	10	12	18	19	21
MLK0603L5N6ST	5	5	5	5	5.1	10	12	18	19	21
MLK0603L6N2ST	5.5	5.5	5.5	5.6	5.7	10	12	18	19	20
MLK0603L6N8JT	6.2	6.1	6.2	6.2	6.4	10	13	19	20	22
MLK0603L7N5JT	6.7	6.6	6.7	6.8	7	10	12	18	19	20
MLK0603L8N2JT	7.4	7.3	7.5	7.6	7.8	10	13	19	20	21
MLK0603L9N1JT	8.2	8.1	8.3	8.4	8.6	10	12	18	18	20
MLK0603L10NJT	9	8.9	9.2	9.3	9.6	10	13	18	19	20
MLK0603L12NJT	10.8	10.6	11	11.2	11.6	10	12	18	18	20
MLK0603L15NJT	13.5	13.4	13.9	14.2	14.8	10	12	17	18	19
MLK0603L18NJT	16.2	16.1	17	17.4	18.4	10	12	16	17	18
MLK0603L22NJT	19.8	19.7	20.9	21.5	22.8	10	12	16	16	17
MLK0603L27NJT	24.4	24.4	27.2	28.6	31.7	10	12	15	15	14
MLK0603L33NJT	29.7	29.7	33.4	35.1	39.3	9	11	14	14	13

Inductance, Q: HP4291A Impedance/gain-phase analyzer or equivalents / 16193A Test fixture or equivalents

MLK Series 0603 Type

Example of mobile phone applications

GSM/DCS1800 Dual-band System



Information on related products

Multilayer Chip Inductors For High-frequency Circuits And Modules

MLK Series 1005 Type

Conforming to RoHS Directive

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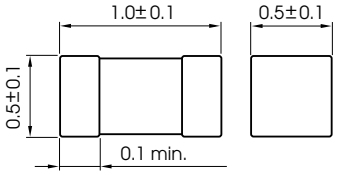
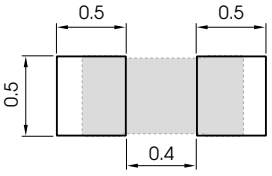
Shapes and dimensions



Weight : 1mg typ.
Dimensions in mm

Recommended PC board pattern

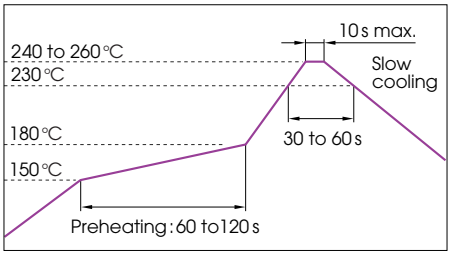
(Reflow process)



Dimensions in mm

Recommended soldering conditions

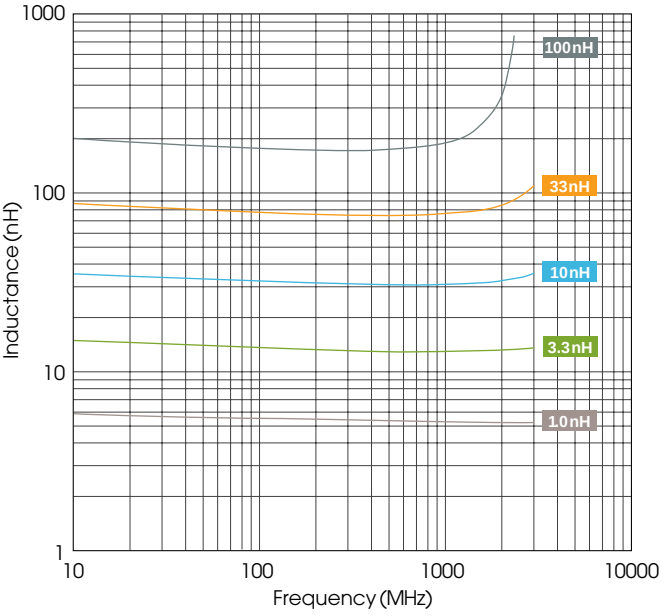
Lead-free solder/High-temperature reflow process



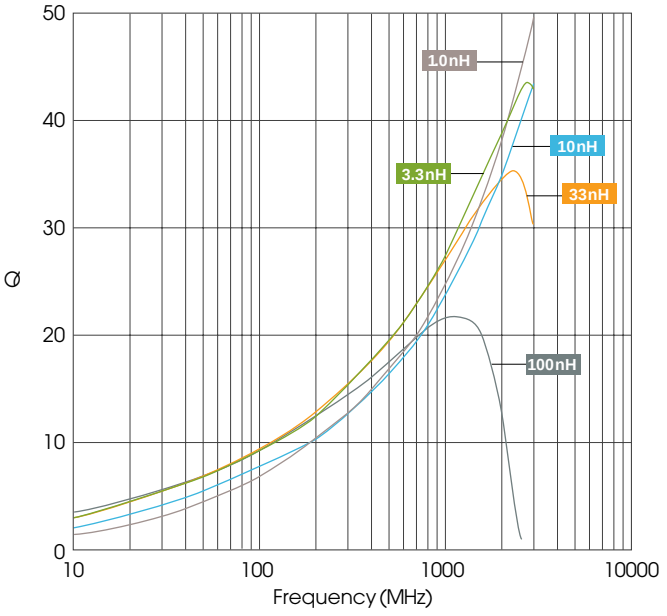
Environmental characteristics

Operating temperature range : −55 to +125°C
Storage temperature rangee : −55 to +125°C

Example of Inductance vs. frequency characteristics



Example of Q vs. frequency characteristics



MLK Series 0603 Type

Example of electrical characteristics

Part No.	Inductance (nH)	Inductance tolerance (%)	Q min.	Inductance, Q test frequency (MHz)	Self-resonance frequency (GHz)		DC resistance (Ω)		Rated current (mA) max.
					min.	typ.	max.	typ.	
MLK1005S1N0ST	1.0	±0.3nH	5	100	12	16.9	0.1	0.05	500
MLK1005S1N1ST	1.1	±0.3nH	5	100	11.5	14.8	0.12	0.05	500
MLK1005S1N2ST	1.2	±0.3nH	5	100	11	14.4	0.12	0.05	500
MLK1005S1N3ST	1.3	±0.3nH	5	100	10	12.6	0.15	0.06	500
MLK1005S1N5ST	1.5	±0.3nH	6	100	9.5	12.2	0.15	0.06	500
MLK1005S1N6ST	1.6	±0.3nH	6	100	9	11.9	0.17	0.06	500
MLK1005S1N8ST	1.8	±0.3nH	6	100	8.5	10.9	0.17	0.07	500
MLK1005S2N0ST	2.0	±0.3nH	6	100	8.3	10	0.18	0.08	500
MLK1005S2N2ST	2.2	±0.3nH	6	100	8	9.6	0.18	0.08	500
MLK1005S2N4ST	2.4	±0.3nH	6	100	7.8	9.5	0.2	0.09	500
MLK1005S2N7ST	2.7	±0.3nH	6	100	7.5	9.1	0.2	0.1	500
MLK1005S3N0ST	3.0	±0.3nH	6	100	7.2	8.5	0.22	0.1	400
MLK1005S3N3ST	3.3	±0.3nH	7	100	7	8.3	0.22	0.11	400
MLK1005S3N6ST	3.6	±0.3nH	7	100	6.8	8.1	0.25	0.11	400
MLK1005S3N9ST	3.9	±0.3nH	7	100	6.5	7.8	0.25	0.12	400
MLK1005S4N3ST	4.3	±0.3nH	7	100	6.3	7.4	0.28	0.13	400
MLK1005S4N7ST	4.7	±0.3nH	7	100	6	6.9	0.28	0.13	400
MLK1005S5N1ST	5.1	±0.3nH	7	100	5.8	7	0.3	0.15	400
MLK1005S5N6ST	5.6	±0.3nH	7	100	5.7	6.7	0.3	0.15	400
MLK1005S5N6DT	5.6	±0.5nH	7	100	5.7	6.7	0,3	0.15	400
MLK1005S6N2ST	6.2	±0.3nH	7	100	5.6	6.5	0.35	0.18	400
MLK1005S6N2DT	6.2	±0.5nH	7	100	5.6	6.5	0.35	0.18	400
MLK1005S6N8DT	6.8	±0.5nH	7	100	5.5	6.3	0.35	0.18	400
MLK1005S6N8JT	6.8	±5%	7	100	5.5	6.3	0.35	0.18	400
MLK1005S7N5DT	7.5	±0.5nH	7	100	5	6	0.38	0.2	350
MLK1005S7N5JT	7.5	±5%	7	100	5	6	0.38	0.2	350
MLK1005S8N2DT	8.2	±0.5nH	7	100	5	6	0.38	0.21	350
MLK1005S8N2JT	8.2	±5%	7	100	5	6	0.38	0.21	350
MLK1005S9N1JT	9.1	±5%	7	100	4.8	5.9	0.42	0.23	350
MLK1005S10NJT	10	±5%	7	100	4.7	5.2	0.42	0.23	350
MLK1005S12NJT	12	±5%	7	100	4.3	5.3	0.47	0.27	350
MLK1005S15NJT	15	±5%	7	100	4	4.8	0.5	0.33	300
MLK1005S18NJT	18	±5%	7	100	4	4.7	0.6	0.38	250
MLK1005S22NJT	22	±5%	7	100	3.5	4.4	0.7	0.46	200
MLK1005S27NJT	27	±5%	7	100	3	3.9	0.8	0.53	200
MLK1005S33NJT	33	±5%	7	100	2.5	3.5	0.9	0.59	200
MLK1005S39NJT	39	±5%	6	100	2	3.1	1	0.65	200
MLK1005S47NJT	47	±5%	6	100	1.8	3	1.2	0.74	200
MLK1005S56NJT	56	±5%	6	100	1.5	2.6	1.3	0.84	200
MLK1005S68NJT	68	±5%	6	100	1.4	2.4	1.5	1.01	150
MLK1005S82NJT	82	±5%	6	100	1.3	2.2	1.8	1.39	150
MLK1005SR10JT	100	±5%	6	100	1.1	1.9	2.2	1.6	100

Inductance, Q: HP4291A Impedance/gain-phase analyzer or equivalents / 16193A Test fixture or equivalents / Self-resonance frequency : HP8720C Network analyzer or equivalents
DC resistance : YOKOGAWA TYPE7561 or equivalents / Rated current : The value where the temperature of the inductor increases by 20°C is applied.

Information on related products

Frequency characteristics / Example of application

Part No.	Inductance(nH) typ. 500MHz	800MHz	1.8GH	2GH	2.4GHz	Q typ. 500MHz	800MHz	1.8GH	2GH	2.4GHz
MLK1005S1N0	0.9	0.9	0.9	0.9	0.9	16	20	30	32	36
MLK1005S1N1	1	1	1	1	1	16	20	32	35	39
MLK1005S1N2	1.1	1.1	1.1	1.1	1.1	15	18	28	30	33
MLK1005S1N3	1.2	1.2	1.2	1.2	1.2	17	20	33	35	39
MLK1005S1N5	1.4	1.4	1.4	1.4	1.4	15	19	29	31	34
MLK1005S1N6	1.5	1.5	1.5	1.5	1.5	17	21	34	36	40
MLK1005S1N8	1.7	1.7	1.7	1.7	1.7	16	21	32	33	37
MLK1005S2N0	1.9	1.8	1.9	1.9	1.9	16	20	32	34	38
MLK1005S2N2	2	2	2	2	2.1	15	19	29	31	34
MLK1005S2N4	2.2	2.2	2.2	2.3	2.3	16	20	32	34	38
MLK1005S2N7	2.5	2.5	2.5	2.6	2.6	17	22	33	35	39
MLK1005S3N0	2.8	2.8	2.8	2.9	2.9	18	22	35	36	41
MLK1005S3N3	3.1	3.1	3.1	3.1	3.2	16	20	31	32	36
MLK1005S3N6	3.4	3.3	3.4	3.5	3.5	17	22	33	35	39
MLK1005S3N9	3.7	3.6	3.7	3.7	3.8	17	21	32	33	37
MLK1005S4N3	4	4	4.1	4.2	4.3	17	22	34	35	39
MLK1005S4N7	4.4	4.4	4.5	4.6	4.7	17	22	33	35	38
MLK1005S5N1	4.8	4.8	4.9	5	5.1	17	22	33	35	38
MLK1005S5N6	5.3	5.2	5.4	5.5	5.7	17	22	33	34	38
MLK1005S6N2	5.8	5.8	6	6.2	6.4	18	23	34	35	39
MLK1005S6N8	6.4	6.4	6.6	6.7	7	17	22	32	33	36
MLK1005S7N5	7.1	7	7.4	7.6	7.9	18	23	34	36	38
MLK1005S8N2	7.7	7.7	8.1	8.3	8.6	19	23	34	36	38
MLK1005S9N1	8.6	8.6	9.1	9.3	9.7	18	23	34	36	38
MLK1005S10N	9.4	9.4	10	10.2	10.7	19	23	34	35	38
MLK1005S12N	11.3	11.3	12.1	12.4	13	19	23	34	35	37
MLK1005S15N	14.2	14.2	15.3	15.8	16.8	18	23	33	34	35
MLK1005S18N	17	17.1	18.6	19.2	20.6	18	23	32	33	34
MLK1005S22N	20.8	20.9	23	23.9	25.8	18	23	32	33	34
MLK1005S27N	25.6	25.9	29.8	31.5	35.7	18	23	30	30	28
MLK1005S33N	31.4	31.9	37.6	40.2		18	23	29	29	
MLK1005S39N	37.2	38.1	48.9			17	21	24		
MLK1005S47N	45	46.2	60.6			18	21	24		
MLK1005S56N	53.7	55.4	76.7			17	21	22		
MLK1005S68N	65.4	68.1	102.3			17	20	19		
MLK1005S82N	79.4	83.3	137.7			16	19	17		
MLK1005SR10	97.4	103.7	204.7			16	19	14		

Inductance, Q: HP4291A Impedance/gain-phase analyzer or equivalents / 16193A Test fixture or equivalents

MLK Series 0603 Type