

3-terminal filters  
For power line  
Feed through filter



# YFF-P series



## FEATURES

- Reduction in ESR, ESL and impedance due to the feed-through structure
- Superior attenuation characteristic in wide bandwidth
- Contributes to reduction in the number of decoupling MLCCs
- Available for large current (2 to 6A)

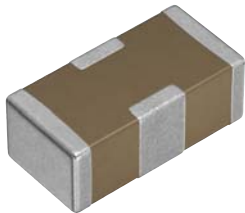
## APPLICATION

- EMC countermeasures and decoupling applications in power lines for communication terminal devices such as smartphones, AV and information devices

## PART NUMBER CONSTRUCTION

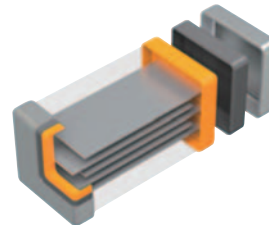
YFF	31	PC	0J	226	M	T	□□	0	N							
Series name	LxW dimensions		Product internal code		Rated voltage		Nominal capacitance		Capacitance tolerance	Packaging style	TDK internal code	Reel size		TDK internal code		
	Code	mm														
	15	1.0x0.5	PC	Standard type	0G	4V	104	100,000pF	M	±20%	T	Taping	0	ø178mm	N	Internal electrode Ni
	18	1.6x0.8	PH	Thickness 0.8mm	0J	6.3V	105	1,000,000pF (1.0µF)					9	ø330mm	E	Internal electrode Ni
	21	2.0x1.2	PW	Low ESL type	1A	10V										
	31	3.2x1.6			1C	16V										
							435	4,300,000pF (4.3µF)								
							226	22,000,000pF (22µF)								

## PRODUCT APPEARANCE



## PRODUCT STRUCTURES

MLCC



Internal electrodes are not conducting between terminal electrodes

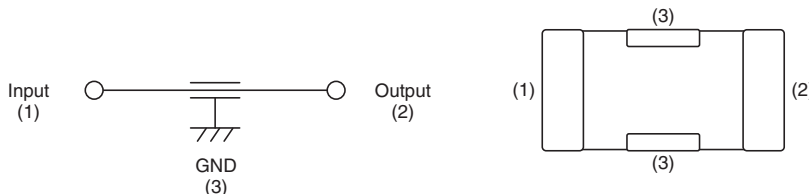
YFF type



Feed-through structure that direct current passes inside the component

■ Sn  
■ Ni  
■ Cu

## EQUIVALENT CIRCUIT



# YFF15PC type

## ELECTRICAL CHARACTERISTICS

### CHARACTERISTICS SPECIFICATION TABLE

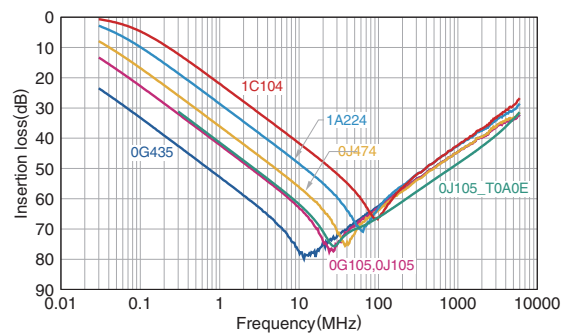
Insertion loss 40dB bandwidth (MHz)	Rated voltage Edc (V)	Rated current Idc (A)	DC resistance (Max.) Rdc (mΩ)	Operating temperature range (°C)	Storage temperature range (After mount) (°C)	Catalog part numbers
0.3 to 1700	4	2	12	-55 to +85	-55 to +85	<a href="#">YFF15PC0G435MT000N</a>
0.3 to 1700	4	2	12	-55 to +85	-55 to +85	<a href="#">YFF15PC0G435MT009N</a>
1 to 2600	6.3	2	30	-55 to +125	-55 to +125	<a href="#">YFF15PC0J105MT0A0E</a>
0.8 to 1800	6.3	3	12	-55 to +105	-55 to +105	<a href="#">YFF15PC0J105MT000N</a>
0.8 to 1800	6.3	3	12	-55 to +105	-55 to +105	<a href="#">YFF15PC0J105MT009N</a>
0.8 to 1800	4	3	12	-55 to +105	-55 to +105	<a href="#">YFF15PC0G105MT000N</a>
0.8 to 1800	4	3	12	-55 to +105	-55 to +105	<a href="#">YFF15PC0G105MT009N</a>
2 to 1700	6.3	3	30	-55 to +105	-55 to +105	<a href="#">YFF15PC0J474MT000N</a>
2 to 1700	6.3	3	30	-55 to +105	-55 to +105	<a href="#">YFF15PC0J474MT009N</a>
4 to 1300	10	3	30	-55 to +105	-55 to +105	<a href="#">YFF15PC1A224MT000N</a>
4 to 1300	10	3	30	-55 to +105	-55 to +105	<a href="#">YFF15PC1A224MT009N</a>
9 to 1300	16	3	30	-55 to +105	-55 to +105	<a href="#">YFF15PC1C104MT000N</a>
9 to 1300	16	3	30	-55 to +105	-55 to +105	<a href="#">YFF15PC1C104MT009N</a>

Click the part number for details.

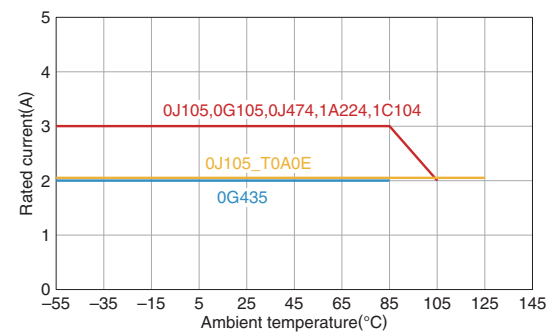
The rated current depends on the operating temperature. For details, refer to RATED CURRENT DERATING graph below.  
The maximum operating temperature includes capacitor self-heating of up to 20°C.

## ELECTRICAL CHARACTERISTICS GRAPH

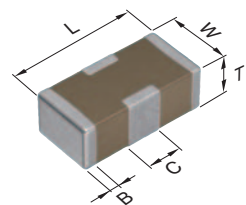
### INSERTION LOSS vs. FREQUENCY



### RATED CURRENT DERATING

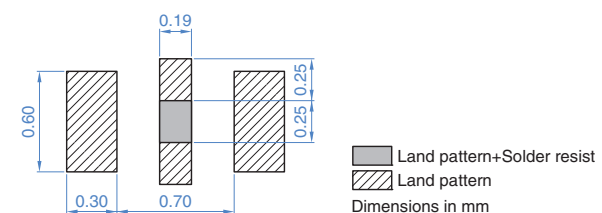


## SHAPE & DIMENSIONS



L	Body length
W	Body width
T	Body height
B	Terminal width
C	GND terminal width

## RECOMMENDED LAND PATTERN



Connect GND terminals and GND of circuit boards by using such as through-holes so that the distance between them becomes the shortest.

L (mm)	W (mm)	T (mm)	B (mm)	C (mm)	Reel size (mm)	Package quantity (pcs./reel)	Catalog part numbers
1.05±0.05	0.65±0.05	0.45±0.05	0.09 min.	0.30±0.10	ø178	10,000	<a href="#">YFF15PC0G435MT000N</a>
1.05±0.05	0.65±0.05	0.45±0.05	0.09 min.	0.30±0.10	ø330	50,000	<a href="#">YFF15PC0G435MT009N</a>
1.00±0.20	0.50±0.20	0.40±0.10	0.18±0.10	0.30±0.10	ø178	10,000	<a href="#">YFF15PC0J105MT0A0E</a>
1.00±0.05	0.55±0.05	0.30±0.05	0.09 min.	0.30±0.10	ø178	10,000	<a href="#">YFF15PC0J105MT000N</a>
1.00±0.05	0.55±0.05	0.30±0.05	0.09 min.	0.30±0.10	ø330	50,000	<a href="#">YFF15PC0J105MT009N</a>
1.00±0.05	0.55±0.05	0.30±0.05	0.09 min.	0.30±0.10	ø178	10,000	<a href="#">YFF15PC0G105MT000N</a>
1.00±0.05	0.55±0.05	0.30±0.05	0.09 min.	0.30±0.10	ø330	50,000	<a href="#">YFF15PC0G105MT009N</a>
1.00±0.05	0.55±0.05	0.30±0.05	0.09 min.	0.30±0.10	ø178	10,000	<a href="#">YFF15PC0J474MT000N</a>
1.00±0.05	0.55±0.05	0.30±0.05	0.09 min.	0.30±0.10	ø330	50,000	<a href="#">YFF15PC0J474MT009N</a>
1.00±0.05	0.55±0.05	0.30±0.05	0.09 min.	0.30±0.10	ø178	10,000	<a href="#">YFF15PC1A224MT000N</a>
1.00±0.05	0.55±0.05	0.30±0.05	0.09 min.	0.30±0.10	ø330	50,000	<a href="#">YFF15PC1A224MT009N</a>
1.00±0.05	0.55±0.05	0.30±0.05	0.09 min.	0.30±0.10	ø178	10,000	<a href="#">YFF15PC1C104MT000N</a>
1.00±0.05	0.55±0.05	0.30±0.05	0.09 min.	0.30±0.10	ø330	50,000	<a href="#">YFF15PC1C104MT009N</a>

Click the part number for details.

# YFF18PC type

## ELECTRICAL CHARACTERISTICS

### CHARACTERISTICS SPECIFICATION TABLE

Insertion loss 40dB bandwidth (MHz)	Rated voltage Edc (V)	Rated current Idc (A)	DC resistance (Max.) Rdc (mΩ)	Operating temperature range (°C)	Storage temperature range (After mount) (°C)	Catalog part numbers
0.2 to 1500	6.3	4	12	-55 to +85	-55 to +85	<a href="#">YFF18PC0J475MT0H0N</a>
0.2 to 1500	6.3	4	12	-55 to +85	-55 to +85	<a href="#">YFF18PC0J475MT0H9N</a>
0.8 to 1600	6.3	4	12	-55 to +105	-55 to +105	<a href="#">YFF18PC0J105MT0H0N</a>
0.8 to 1600	6.3	4	12	-55 to +105	-55 to +105	<a href="#">YFF18PC0J105MT0H9N</a>
2 to 1100	6.3	4	30	-55 to +125	-55 to +125	<a href="#">YFF18PC0J474MT0H0N</a>
2 to 1100	6.3	4	30	-55 to +125	-55 to +125	<a href="#">YFF18PC0J474MT0H9N</a>
3 to 1800	6.3	4	30	-55 to +125	-55 to +125	<a href="#">YFF18PC0J224MT0H0N</a>
3 to 1800	6.3	4	30	-55 to +125	-55 to +125	<a href="#">YFF18PC0J224MT0H9N</a>
7 to 1100	16	4	30	-55 to +125	-55 to +125	<a href="#">YFF18PC1C104MT0H0N</a>
7 to 1100	16	4	30	-55 to +125	-55 to +125	<a href="#">YFF18PC1C104MT0H9N</a>

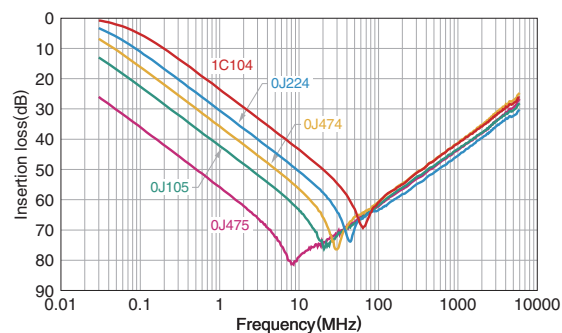
Click the part number for details.

The rated current depends on the operating temperature. For details, refer to RATED CURRENT DERATING graph below.

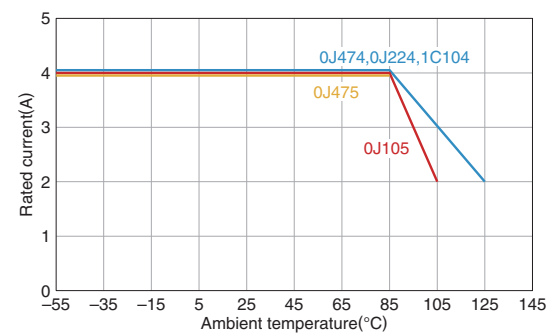
The maximum operating temperature includes capacitor self-heating of up to 20°C.

## ELECTRICAL CHARACTERISTICS GRAPH

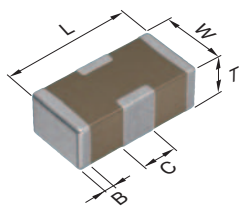
### INSERTION LOSS vs. FREQUENCY



### RATED CURRENT DERATING

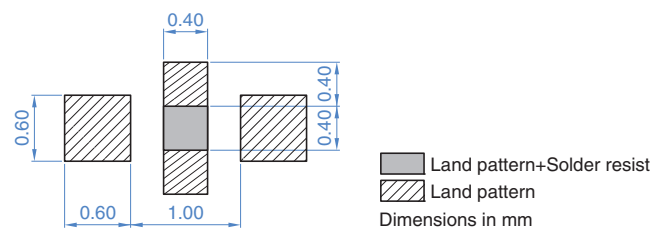


## SHAPE & DIMENSIONS



L	Body length
W	Body width
T	Body height
B	Terminal width
C	GND terminal width

## RECOMMENDED LAND PATTERN



Connect GND terminals and GND of circuit boards by using such as through-holes so that the distance between them becomes the shortest.

L (mm)	W (mm)	T (mm)	B (mm)	C (mm)	Reel size (mm)	Package quantity (pcs./reel)	Catalog part numbers
1.60±0.20	0.80±0.10	0.60±0.10	0.25±0.15	0.40±0.10	ø178	4,000	<a href="#">YFF18PC0J475MT0H0N</a>
1.60±0.20	0.80±0.10	0.60±0.10	0.25±0.15	0.40±0.10	ø330	10,000	<a href="#">YFF18PC0J475MT0H9N</a>
1.60±0.20	0.80±0.10	0.60±0.10	0.25±0.15	0.40±0.10	ø178	4,000	<a href="#">YFF18PC0J105MT0H0N</a>
1.60±0.20	0.80±0.10	0.60±0.10	0.25±0.15	0.40±0.10	ø330	10,000	<a href="#">YFF18PC0J105MT0H9N</a>
1.60±0.20	0.80±0.10	0.60±0.10	0.25±0.15	0.40±0.10	ø178	4,000	<a href="#">YFF18PC0J474MT0H0N</a>
1.60±0.20	0.80±0.10	0.60±0.10	0.25±0.15	0.40±0.10	ø330	10,000	<a href="#">YFF18PC0J474MT0H9N</a>
1.60±0.20	0.80±0.10	0.60±0.10	0.25±0.15	0.40±0.10	ø178	4,000	<a href="#">YFF18PC0J224MT0H0N</a>
1.60±0.20	0.80±0.10	0.60±0.10	0.25±0.15	0.40±0.10	ø330	10,000	<a href="#">YFF18PC0J224MT0H9N</a>
1.60±0.20	0.80±0.10	0.60±0.10	0.25±0.15	0.40±0.10	ø178	4,000	<a href="#">YFF18PC1C104MT0H0N</a>
1.60±0.20	0.80±0.10	0.60±0.10	0.25±0.15	0.40±0.10	ø330	10,000	<a href="#">YFF18PC1C104MT0H9N</a>

Click the part number for details.

# YFF18PH type

## ELECTRICAL CHARACTERISTICS

### CHARACTERISTICS SPECIFICATION TABLE

Insertion loss 40dB bandwidth (MHz)	Rated voltage Edc (V)	Rated current Idc (A)	DC resistance (Max.) Rdc (mΩ)	Operating temperature range (°C)	Storage temperature range (After mount) (°C)	Catalog part numbers
0.3 to 1700	6.3	4	10	-55 to +125	-55 to +125	<a href="#">YFF18PH0J106MT00HE</a>
0.4 to 1500	6.3	4	12	-55 to +85	-55 to +85	<a href="#">YFF18PH0J225MT000N</a>
0.4 to 1500	6.3	4	12	-55 to +85	-55 to +85	<a href="#">YFF18PH0J225MT009N</a>
0.7 to 1100	6.3	4	12	-55 to +105	-55 to +105	<a href="#">YFF18PH0J105MT000N</a>
0.7 to 1100	6.3	4	12	-55 to +105	-55 to +105	<a href="#">YFF18PH0J105MT009N</a>

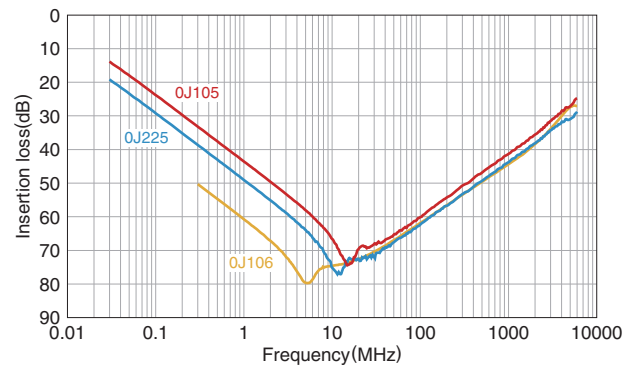
Click the part number for details.

The rated current depends on the operating temperature. For details, refer to RATED CURRENT DERATING graph below.

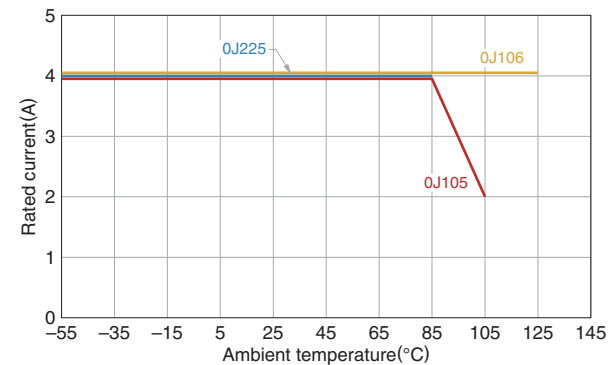
The maximum operating temperature includes capacitor self-heating of up to 20°C.

## ELECTRICAL CHARACTERISTICS GRAPH

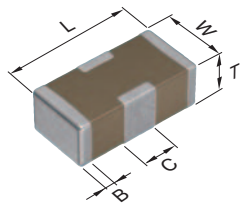
### INSERTION LOSS vs. FREQUENCY



### RATED CURRENT DERATING

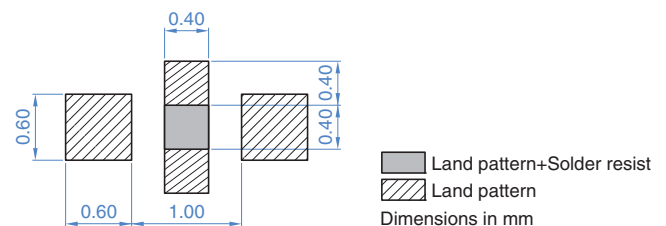


## SHAPE & DIMENSIONS



L	Body length
W	Body width
T	Body height
B	Terminal width
C	GND terminal width

## RECOMMENDED LAND PATTERN



Connect GND terminals and GND of circuit boards by using such as through-holes so that the distance between them becomes the shortest.

L (mm)	W (mm)	T (mm)	B (mm)	C (mm)	Reel size (mm)	Package quantity (pcs./reel)	Catalog part numbers
1.60+0.30,-0.10	0.80+0.30,-0.10	0.80+0.30,-0.10	0.25±0.20	0.40±0.20	ø178	3,000	<a href="#">YFF18PH0J106MT00HE</a>
1.60±0.20	0.80±0.10	0.80±0.10	0.25±0.15	0.40±0.10	ø178	4,000	<a href="#">YFF18PH0J225MT000N</a>
1.60±0.20	0.80±0.10	0.80±0.10	0.25±0.15	0.40±0.10	ø330	10,000	<a href="#">YFF18PH0J225MT009N</a>
1.60±0.20	0.80±0.10	0.80±0.10	0.25±0.15	0.40±0.10	ø178	4,000	<a href="#">YFF18PH0J105MT000N</a>
1.60±0.20	0.80±0.10	0.80±0.10	0.25±0.15	0.40±0.10	ø330	10,000	<a href="#">YFF18PH0J105MT009N</a>

Click the part number for details.

# YFF18PW type

## ELECTRICAL CHARACTERISTICS

### CHARACTERISTICS SPECIFICATION TABLE

Insertion loss 40dB bandwidth (MHz)	Rated voltage Edc (V)	Rated current Idc (A)	DC resistance (Max.) Rdc (mΩ)	Operating temperature range (°C)	Storage temperature range (After mount) (°C)	Catalog part numbers
0.2 to 2700	6.3	4	12	-55 to +85	-55 to +85	<a href="#">YFF18PWQJ475MT0H0N</a>
0.2 to 2700	6.3	4	12	-55 to +85	-55 to +85	<a href="#">YFF18PWQJ475MT0H9N</a>
0.8 to 2400	6.3	4	30	-55 to +105	-55 to +105	<a href="#">YFF18PWQJ105MT0H0N</a>
0.8 to 2400	6.3	4	30	-55 to +105	-55 to +105	<a href="#">YFF18PWQJ105MT0H9N</a>
2 to 2400	6.3	4	30	-55 to +125	-55 to +125	<a href="#">YFF18PWQJ474MT0H0N</a>
2 to 2400	6.3	4	30	-55 to +125	-55 to +125	<a href="#">YFF18PWQJ474MT0H9N</a>

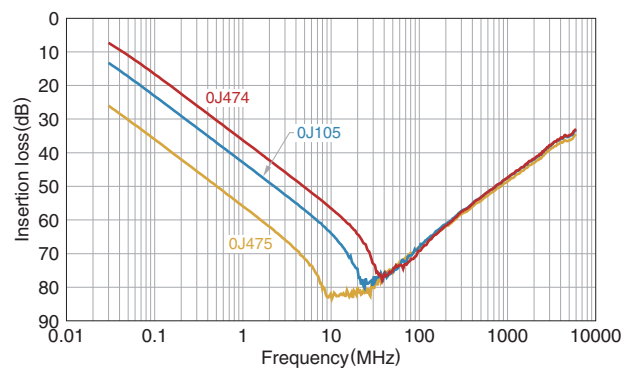
Click the part number for details.

The rated current depends on the operating temperature. For details, refer to RATED CURRENT DERATING graph below.

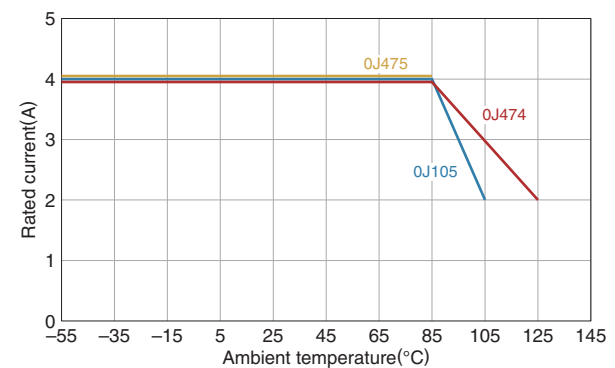
The maximum operating temperature includes capacitor self-heating of up to 20°C.

## ELECTRICAL CHARACTERISTICS GRAPH

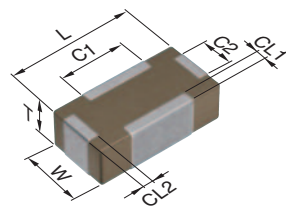
### INSERTION LOSS vs. FREQUENCY



### RATED CURRENT DERATING

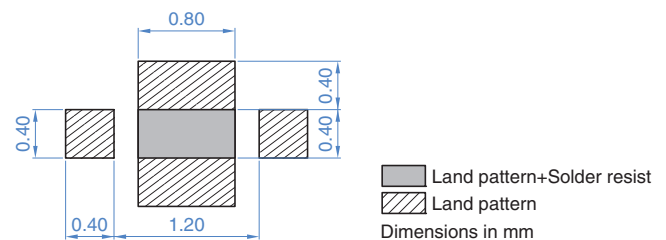


## SHAPE & DIMENSIONS



L	Body length
W	Body width
T	Body height
C1	GND terminal width 1
CL1	GND terminal width 2
C2	Terminal width 1
CL2	Terminal width 2

## RECOMMENDED LAND PATTERN



Connect GND terminals and GND of circuit boards by using such as through-holes so that the distance between them becomes the shortest.

L (mm)	W (mm)	T (mm)	C1 (mm)	CL1 (mm)	C2 (mm)	CL2 (mm)	Reel size(mm)	Package quantity (pcs./reel)	Catalog part numbers
1.60±0.10	0.80±0.10	0.60±0.10	0.80+0.20,-0.10	0.15±0.10	0.40±0.10	0.15±0.10	φ178	4,000	<a href="#">YFF18PWQJ475MT0H0N</a>
1.60±0.10	0.80±0.10	0.60±0.10	0.80+0.20,-0.10	0.15±0.10	0.40±0.10	0.15±0.10	φ330	10,000	<a href="#">YFF18PWQJ475MT0H9N</a>
1.60±0.10	0.80±0.10	0.60±0.10	0.80+0.20,-0.10	0.15±0.10	0.40±0.10	0.15±0.10	φ178	4,000	<a href="#">YFF18PWQJ105MT0H0N</a>
1.60±0.10	0.80±0.10	0.60±0.10	0.80+0.20,-0.10	0.15±0.10	0.40±0.10	0.15±0.10	φ330	10,000	<a href="#">YFF18PWQJ105MT0H9N</a>
1.60±0.10	0.80±0.10	0.60±0.10	0.80+0.20,-0.10	0.15±0.10	0.40±0.10	0.15±0.10	φ178	4,000	<a href="#">YFF18PWQJ474MT0H0N</a>
1.60±0.10	0.80±0.10	0.60±0.10	0.80+0.20,-0.10	0.15±0.10	0.40±0.10	0.15±0.10	φ330	10,000	<a href="#">YFF18PWQJ474MT0H9N</a>

Click the part number for details.

# YFF21PC type

## ELECTRICAL CHARACTERISTICS

### CHARACTERISTICS SPECIFICATION TABLE

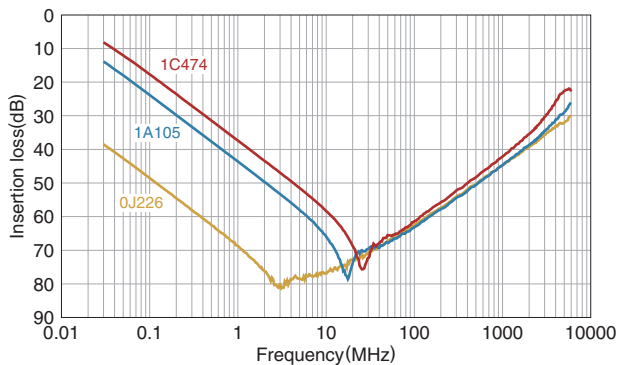
Insertion loss 40dB bandwidth (MHz)	Rated voltage Edc (V)	Rated current Idc (A)	DC resistance (Max.) Rdc (mΩ)	Operating temperature range (°C)	Storage temperature range (After mount) (°C)	Catalog part numbers
0.04 to 1700	6.3	4	5	-55 to +85	-55 to +85	<a href="#">YFF21PC0J226MT000N</a>
0.04 to 1700	6.3	4	5	-55 to +85	-55 to +85	<a href="#">YFF21PC0J226MT009N</a>
0.7 to 1600	10	4	12	-55 to +85	-55 to +85	<a href="#">YFF21PC1A105MT000N</a>
0.7 to 1600	10	4	12	-55 to +85	-55 to +85	<a href="#">YFF21PC1A105MT009N</a>
2 to 1200	16	2	30	-55 to +125	-55 to +125	<a href="#">YFF21PC1C474MT000N</a>
2 to 1200	16	2	30	-55 to +125	-55 to +125	<a href="#">YFF21PC1C474MT009N</a>

Click the part number for details.

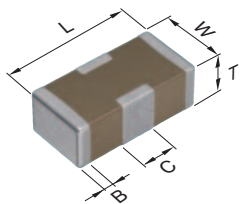
The maximum operating temperature includes capacitor self-heating of up to 20°C.

## ELECTRICAL CHARACTERISTICS GRAPH

### INSERTION LOSS vs. FREQUENCY

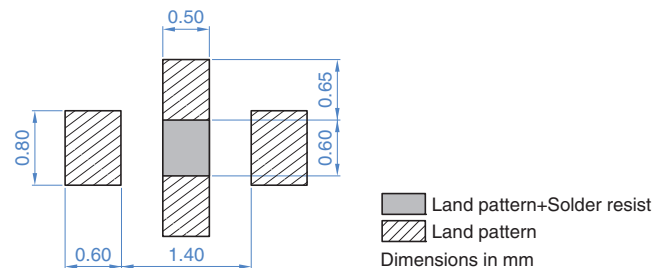


## SHAPE & DIMENSIONS



L	Body length
W	Body width
T	Body height
B	Terminal width
C	GND terminal width

## RECOMMENDED LAND PATTERN



Connect GND terminals and GND of circuit boards by using such as through-holes so that the distance between them becomes the shortest.

L (mm)	W (mm)	T (mm)	B (mm)	C (mm)	Reel size (mm)	Package quantity (pcs./reel)	Catalog part numbers
2.00±0.20	1.25±0.20	0.85±0.15	0.30±0.10	0.45±0.15	ø178	4,000	<a href="#">YFF21PC0J226MT000N</a>
2.00±0.20	1.25±0.20	0.85±0.15	0.30±0.10	0.45±0.15	ø330	10,000	<a href="#">YFF21PC0J226MT009N</a>
2.00±0.20	1.25±0.20	0.85±0.15	0.30±0.10	0.45±0.15	ø178	4,000	<a href="#">YFF21PC1A105MT000N</a>
2.00±0.20	1.25±0.20	0.85±0.15	0.30±0.10	0.45±0.15	ø330	10,000	<a href="#">YFF21PC1A105MT009N</a>
2.00±0.20	1.25±0.20	0.85±0.15	0.30±0.10	0.45±0.15	ø178	4,000	<a href="#">YFF21PC1C474MT000N</a>
2.00±0.20	1.25±0.20	0.85±0.15	0.30±0.10	0.45±0.15	ø330	10,000	<a href="#">YFF21PC1C474MT009N</a>

Click the part number for details.

# YFF31PC type

## ELECTRICAL CHARACTERISTICS

### CHARACTERISTICS SPECIFICATION TABLE

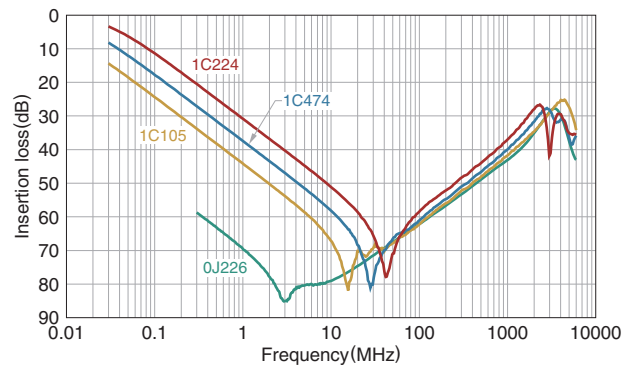
Insertion loss 40dB bandwidth (MHz)	Rated voltage Edc (V)	Rated current Idc (A)	DC resistance (Max.) Rdc (mΩ)	Operating temperature range (°C)	Storage temperature range (After mount) (°C)	Catalog part numbers
0.3 to 1300	6.3	6	5	-55 to +125	-55 to +125	<a href="#">YFF31PC0J226MTJ00N</a>
0.7 to 1200	16	2	40	-55 to +125	-55 to +125	<a href="#">YFF31PC1C105MT000N</a>
0.7 to 1200	16	2	40	-55 to +125	-55 to +125	<a href="#">YFF31PC1C105MT009N</a>
2 to 1000	16	2	40	-55 to +125	-55 to +125	<a href="#">YFF31PC1C474MT000N</a>
2 to 1000	16	2	40	-55 to +125	-55 to +125	<a href="#">YFF31PC1C474MT009N</a>
3 to 700	16	2	40	-55 to +125	-55 to +125	<a href="#">YFF31PC1C224MT000N</a>
3 to 700	16	2	40	-55 to +125	-55 to +125	<a href="#">YFF31PC1C224MT009N</a>

Click the part number for details.

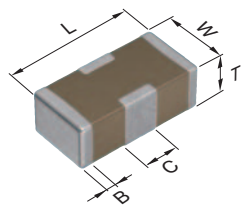
The maximum operating temperature includes capacitor self-heating of up to 20°C.

## ELECTRICAL CHARACTERISTICS GRAPH

### INSERTION LOSS vs. FREQUENCY

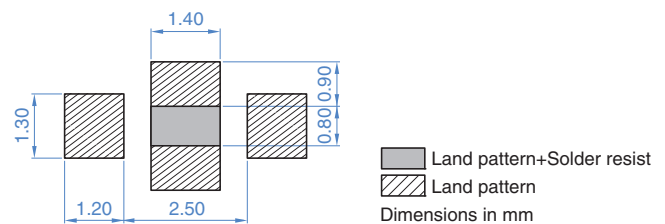


## SHAPE & DIMENSIONS



L	Body length
W	Body width
T	Body height
B	Terminal width
C	GND terminal width

## RECOMMENDED LAND PATTERN



Connect GND terminals and GND of circuit boards by using such as through-holes so that the distance between them becomes the shortest.

L (mm)	W (mm)	T (mm)	B (mm)	C (mm)	Reel size (mm)	Package quantity (pcs./reel)	Catalog part numbers
3.20±0.20	1.60±0.20	1.30±0.20	0.40±0.30	1.10±0.40	ø178	2,000	<a href="#">YFF31PC0J226MTJ00N</a>
3.20±0.20	1.60±0.20	1.30±0.20	0.40±0.30	0.95±0.25	ø178	2,000	<a href="#">YFF31PC1C105MT000N</a>
3.20±0.20	1.60±0.20	1.30±0.20	0.40±0.30	0.95±0.25	ø330	10,000	<a href="#">YFF31PC1C105MT009N</a>
3.20±0.20	1.60±0.20	1.30±0.20	0.40±0.30	0.95±0.25	ø178	2,000	<a href="#">YFF31PC1C474MT000N</a>
3.20±0.20	1.60±0.20	1.30±0.20	0.40±0.30	0.95±0.25	ø330	10,000	<a href="#">YFF31PC1C474MT009N</a>
3.20±0.20	1.60±0.20	1.30±0.20	0.40±0.30	0.95±0.25	ø178	2,000	<a href="#">YFF31PC1C224MT000N</a>
3.20±0.20	1.60±0.20	1.30±0.20	0.40±0.30	0.95±0.25	ø330	10,000	<a href="#">YFF31PC1C224MT009N</a>

Click the part number for details.

# REMINDERS FOR USING THESE PRODUCTS

Before using these products, be sure to request the delivery specifications.

## SAFETY REMINDERS

Please pay sufficient attention to the warnings for safe designing when using this products.

### REMINDERS

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If you intend to use the products in the applications listed below or if you have special requirements exceeding the range or conditions set forth in the each catalog, please contact us.

- |  |  |
|--|--|
| (1) Aerospace/aviation equipment   | (8) Public information-processing equipment                                  |
| (2) Transportation equipment (cars, electric trains, ships, etc.)                    | (9) Military equipment   |
| (3) Medical equipment (excepting Pharmaceutical Affairs Law classification Class1,2) | (10) Electric heating apparatus, burning equipment                           |
| (4) Power-generation control equipment   | (11) Disaster prevention/crime prevention equipment                          |
| (5) Atomic energy-related equipment  | (12) Safety equipment  |
| (6) Seabed equipment   | (13) Other applications that are not considered general-purpose applications |
| (7) Transportation control equipment   |  |

When designing your equipment even for general-purpose applications, you are kindly requested to take into consideration securing protection circuit/device or providing backup circuits in your equipment.

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