

## Overview

The KEMET ESD-R series solid toroidal cores are designed to use on round cables. The wide range of Manganese Zinc (MnZn) and Nickel Zinc (NiZn) options are available in bare, coated, and case types and allows for targeting of specific frequency ranges.

EMI cores are part of a family of passive components, which address the issues of noise or electromagnetic interference (EMI) in circuits or systems.

## Applications

- Consumer electronics
- Air conditioners
- Power conditioners
- Refrigerators
- Washing machines
- Industrial equipment
- Medical equipment
- Adapters
- Computers
- Telecommunications

## Benefits

- MnZn  $\leq$  10 MHz (AM band range) and NiZn  $\leq$  500 MHz (FM band range) options available
- Solid construction
- Bare, coated, and case types available
- Wide range of products available

Bare Type



Coated Type



Case Type



## EMI Cores

### ESD-R Toroidal Cores for Round Cables for Low & High Frequency (Bare, coated & with case)

## Part Number System

ESD-	R-	10	D
Series	Shape Type	Core Size Outer Dimension Code (mm)	Internal Management Code
ESD-	Ring	See Table 1	

## Turns and Impedance Characteristics

When the desired performance of an EMI core cannot be obtained with a single pass through the core, the impedance characteristics can be changed with multiple turns.

A turn is counted by the number of lead-wire windings which pass through the inner hole of the core. Windings on the outside of the core do not count.

See Figure 1 for examples of one, two, and three turns.

Adding turns will result in higher impedance while also lowering the effective frequency range.

See Figure 2 for an example.

Figure 1 – How to count turns

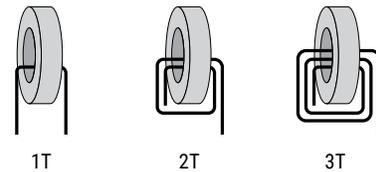
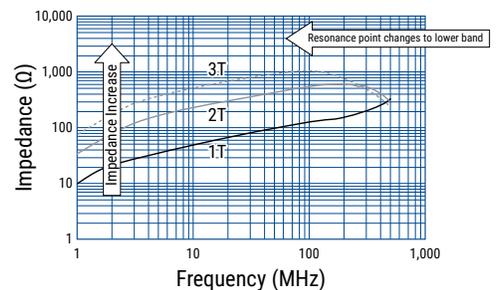


Figure 2 – Relationship between impedance and turn count. (Representative example: ESD-R-16C)



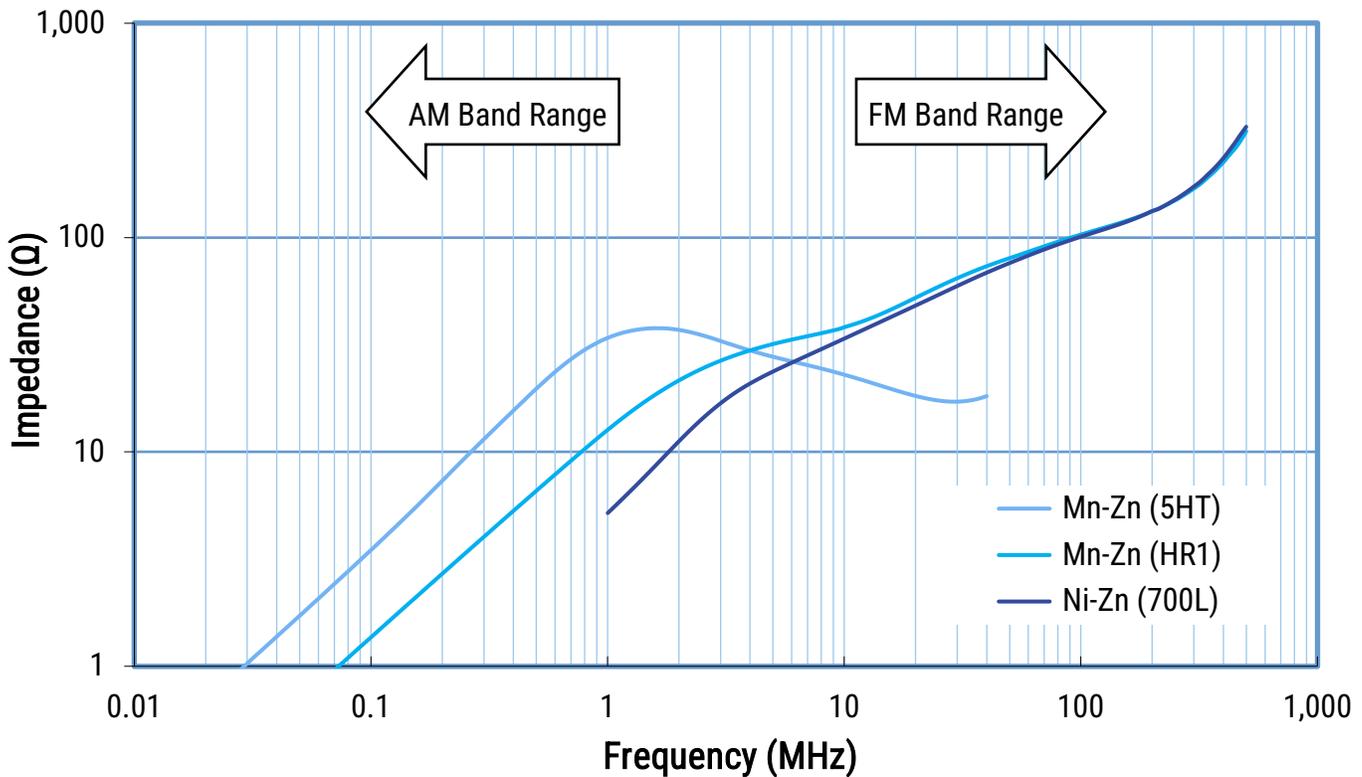
### Core Material and Effective Frequency Range

There are three ferrite material options for KEMET EMI Cores: 700L Nickel Zinc (Ni-Zn), HR1 and 5HT Manganese Zinc (Mn-Zn). Each core material has a different resistance and effective frequency range. The MnZn core material has a lower resistance compared to the Ni-Zn; therefore, adequate insulation is required before use.

The 700L Ni-Zn core material is typically effective for frequencies in the MHz band range such as the FM band, while the 5HT Mn-Zn core material is typically effective for the kHz band range such as the AM band. The HR1 Manganese Zinc core material provides excellent performance in the MHz band range and represents a cost effective replacement solution of the traditional Ni-Zn core material in the FM band. See Figure 3.

It is recommended to measure the actual frequency range effectiveness in the target application.

Figure 3 - Effective band range of Mn-Zn and Ni-Zn ferrite core materials.  
(Representative example, measured with same-dimension ring core)



## Magnetic Permeability of Ferrite Material

In order to achieve most efficient noise reduction, it is important to select the material according to the target frequency band.

Depending on its magnetic permeability, a particular ferrite material will be effective in a certain frequency band.

A schematic representation of the relationship between the magnetic permeability of each material and the corresponding effective band range is shown in Figure 4.

Materials with higher magnetic permeability are effective in the lower frequency range, while those with lower magnetic permeability are effective in the higher frequency range. Thus, Mn-Zn products are mainly used for reducing conduction noise, while Ni-Zn products are commonly used for radiation noise countermeasures.

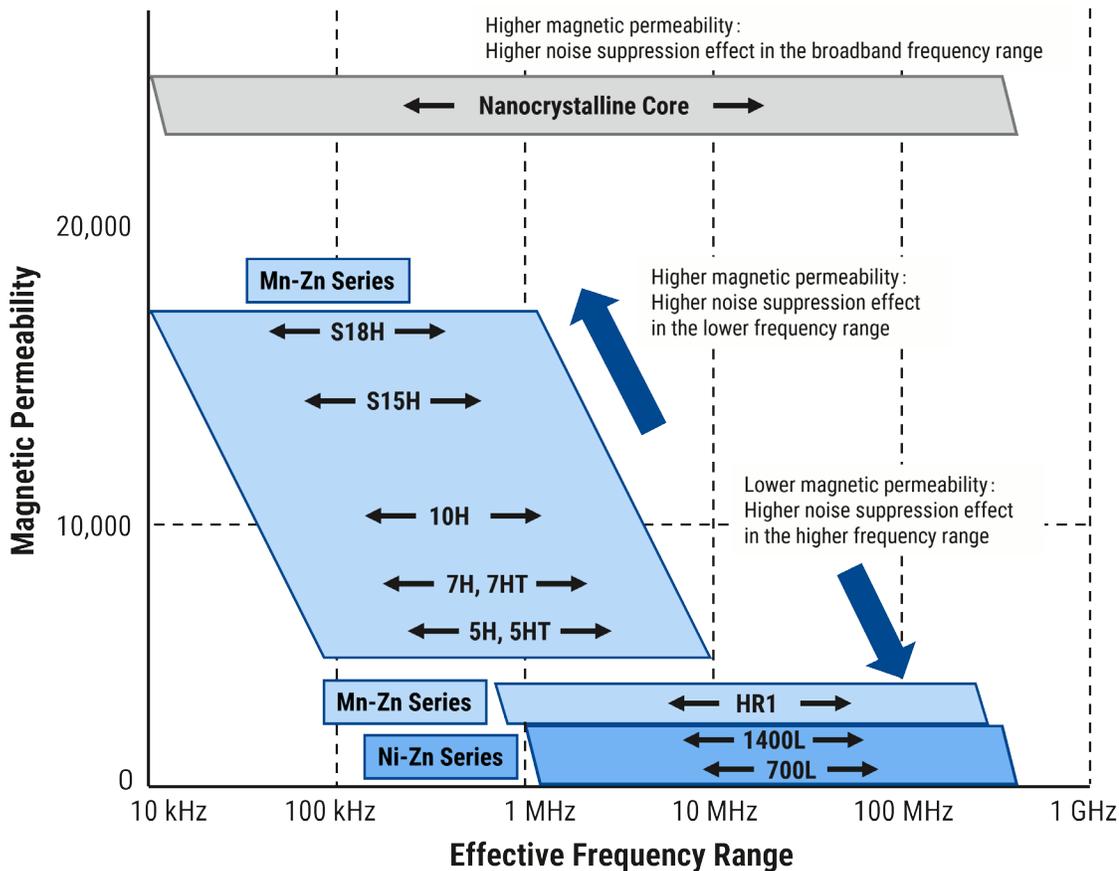
The effective frequency range varies depending on core shape, size and number of turns.

This frequency dependence of the magnetic permeability as shown in the figure serves for reference purposes only and it should be tested on the actual device to determine its effectiveness.

S18H, S15H, 10H, 7H, 7HT, 5H, 5HT, HR1, 1400L and 700L are KEMET's proprietary ferrite material names.

Other materials can also be available on request.

Figure 4 - Relationship between the magnetic permeability of each material and its effective frequency range



## EMI Cores

ESD-R Toroidal Cores for Round Cables for  
Low & High Frequency (Bare, coated & with case)

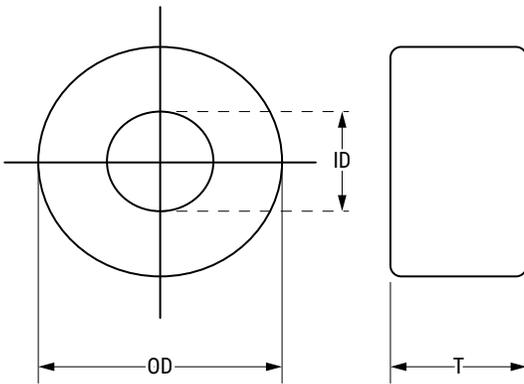
### Environmental Compliance

All KEMET EMI cores are RoHS compliant.

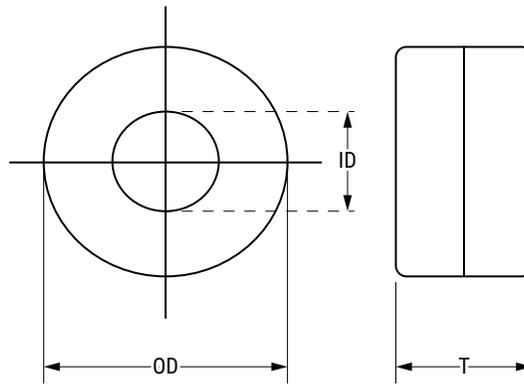


### Dimensions – Millimeters

Bare and Coated Types

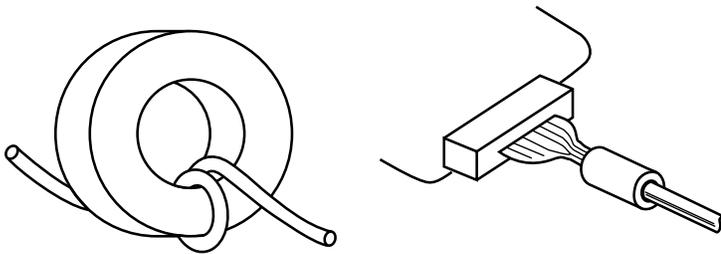


Case Type



See Table 1 for dimensions

### Installation Example



## Performance Characteristics

Item	Performance Characteristics
Operating temperature	Bare and coated: -25°C to +85°C
	Case : -25°C to +60°C
Frequency range	Low frequency and high frequency
Outer diameter	9.5 – 61 mm
Inner diameter	5.0 – 36 mm
Thickness	3 – 28.8 mm
Type	Bare, coated and case
Case flame resistant rating	UL94 V-2
Material	MnZn 5H, MnZn 7H and NiZn 700L

Table 1 – Ratings &amp; Part Number Reference

Part Number	Dimensions (mm)			Weight (g)	Type	Color	Compatible Toroid Core (Bare Type)	Frequency Range <sup>1</sup>		Material	
	OD	ID	T					≤ 10 MHz (AM band range)	≤ 500 MHz (FM band range)	MnZn	NiZn
ESD-R-12E	11.8 ±0.7	7.3 ±0.7	8.0 ±0.7	2.7	Bare	–	–		X	–	700L
ESD-R-12S	12.0 ±0.5	7.0 ±0.4	5.5 ±0.4	2.1	Bare	–	–		X	–	700L
ESD-R-14C	14.0 ±0.7	7.0 ±0.7	3.0 ±0.7	1.7	Bare	–	–		X	–	700L
ESD-R-15C-1	15.0 ±0.5	10.5 ±0.5	12.0 ±0.5	5.3	Bare	–	–		X	–	700L
ESD-R-16	15.8 ±0.6	11.6 ±0.6	8.4 ±0.6	3.6	Bare	–	–	X		5H	–
ESD-R-19S	18.5 ±1.0	10.0 ±1.0	10.0 ±1.0	10.4	Bare	–	–	X		5H	–
ESD-R-25S	25.0 ±0.8	15.0 ±0.8	12.0 ±0.8	18.5	Bare	–	–	X		5H	–
ESD-R-25SH	25.0 ±0.8	15.0 ±0.8	12.0 ±0.8	18.6	Bare	–	–	X		7H	–
ESD-R-27S	27.0 ±0.8	19.0 ±0.8	15.0 ±0.5	21.3	Bare	–	–	X		10H	–
ESD-R-28C	28.0 ±0.8	16.0 ±0.5	13.0 ±0.6	27.3	Bare	–	–		X	–	700L
ESD-R-31C	31.0 ±0.8	19.0 ±0.5	8.0 ±0.5	18.1	Bare	–	–		X	–	700L
ESD-R-38D	38.1 ±1.0	19.0 ±0.7	12.7 ±0.7	53.0	Bare	–	–	X		5H	–
ESD-R-47S	47.0 ±1.0	27.0 ±0.8	15.0 ±0.5	83.7	Bare	–	–	X		5H	–
ESD-R-57D	57.0 ±1.5	36.0 ±1.5	20.0 ±0.7	139.1	Bare	–	–		X	–	700L
ESD-R-57S	57.0 ±1.5	36.0 ±1.0	20.0 ±0.5	139.1	Bare	–	–	X		5H	–
ESD-R-12-C-2	12.0 ±0.7	7.3 ±0.7	15.3 ±0.7	5.0	Coated	Blue	–		X	–	1400L
ESD-R-12C-M	12.0 ±0.5	7.0 ±0.5	15.0 ±0.7	5.0	Coated	Gray	ESD-R-12C		X	–	700L
ESD-R-14A	15.0 Maximum	6.2 Minimum	3.5 Maximum	1.8	Coated	Green	–	X		5H	–
ESD-R-14C-2	14.0 ±0.5	7.0 ±0.5	3.0 ±0.5	1.7	Coated	Blue	ESD-R-14C		X	–	700L
ESD-R-15C	15.2 ±0.5	10.5 ±0.5	12.5 ±0.5	5.3	Coated	Blue	ESD-R-15C-1		X	–	700L
ESD-R-19E-1	19.0 ±0.5	10.7 ±0.5	5.3 ±0.5	6.0	Coated	Blue	–		X	–	700L
ESD-R-25D-8	25.0 ±0.5	15.0 ±0.5	8.0 ±0.5	12.9	Coated	Blue	–		X	–	700L
ESD-R-25MK	25.3 ±0.6	14.8 ±0.6	12.3 ±0.6	21.0	Coated	Gray	ESD-R-25S	X		5H	–
ESD-R-28C-1	28.2 ±0.8	15.8 ±0.5	13.2 ±0.6	28.3	Coated	Blue	–		X	–	700L
ESD-R-31C-1	32.0 Maximum	18.5 Minimum	9.0 Maximum	18.5	Coated	Green	ESD-R-31C		X	–	700L
ESD-R-31-P	32.0 Maximum	19.0 Minimum	15.8 Maximum	32.2	Coated	Green	–	X		5H	–
ESD-R-38-P	39.5 Maximum	18.0 Minimum	14.0 Maximum	52.8	Coated	Green	–	X		5H	–
ESD-R-47-P	48.5 Maximum	26.0 Minimum	16.0 Maximum	84.8	Coated	Green	–	X		5H	–
ESD-R-57-P	59.0 Maximum	34.0 Minimum	21.0 Maximum	140.9	Coated	Green	–	X		5H	–
ESD-R-12D	12.9 ±1.0	6.0 ±1.0	6.4 ±1.0	2.4	Case	Black	ESD-R-12S		X	–	700L
ESD-R-19	19.0 ±1.0	9.0 ±1.0	11.0 ±1.0	11.1	Case	White	ESD-R-19S	X		5H	–
ESD-R-25	26.0 ±1.0	14.0 ±1.0	15.0 ±1.0	20.4	Case	White	ESD-R-25S	X		5H	–
Part Number	OD	ID	T	Weight (g)	Type	Color	Compatible Toroid Core (Bare Type)	≤ 10 MHz (AM band range)	≤ 300 MHz (FM band range)	MnZn	NiZn
	Dimensions							Frequency Range <sup>1</sup>	Material		

<sup>1</sup> Frequency range is for reference only. Please test with actual device before use.

\* Other sizes available on request. Please contact KEMET.

## EMI Cores

### ESD-R Toroidal Cores for Round Cables for Low & High Frequency (Bare, coated & with case)

**Table 1 – Ratings & Part Number Reference cont.**

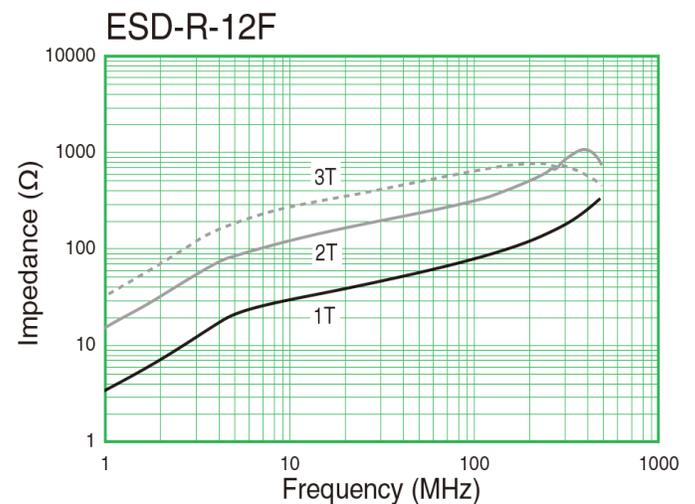
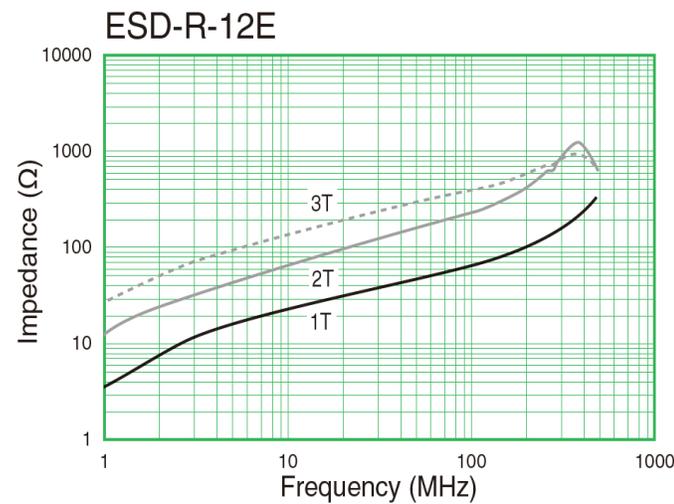
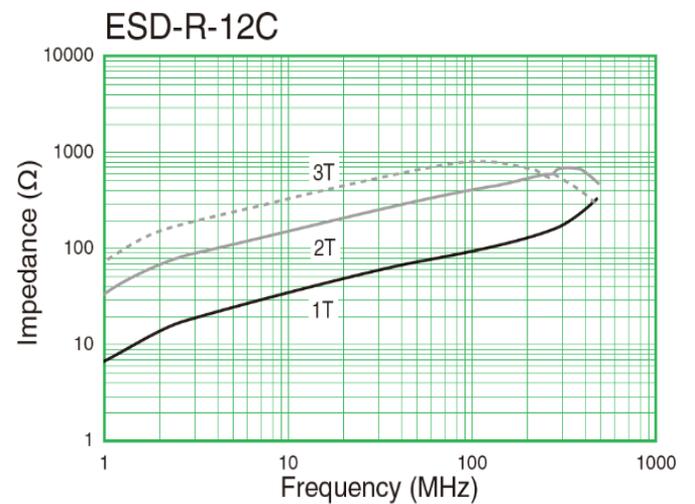
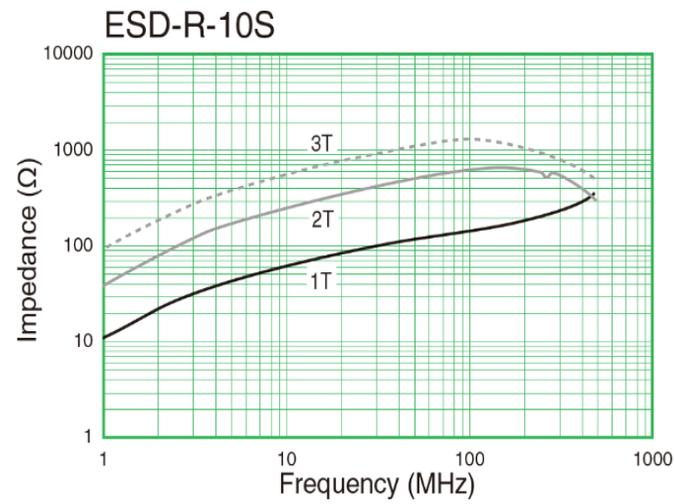
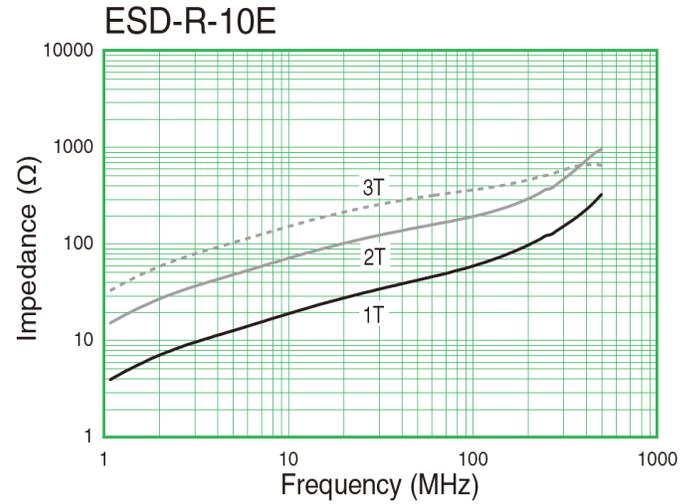
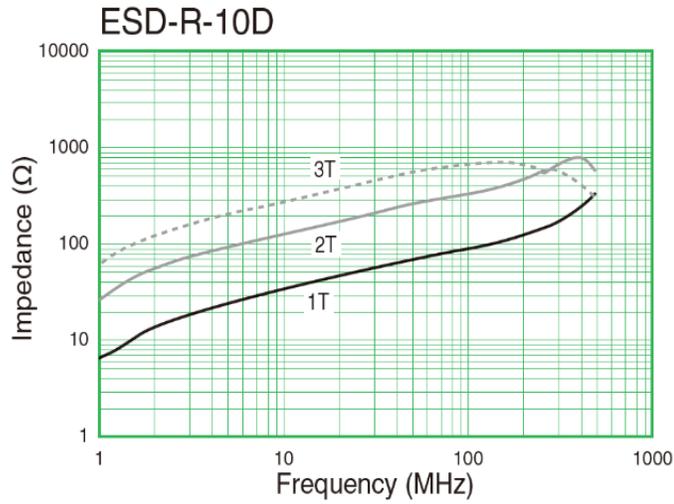
Part Number	Dimensions (mm)			Weight (g)	Type	Color	Compatible Toroid Core (Bare Type)	Frequency Range <sup>1</sup>		Material	
	OD	ID	T					≤ 10 MHz (AM band range)	≤ 500 MHz (FM band range)	MnZn	NiZn
ESD-R-25D	26.0 ±1.0	14.0 ±1.0	15.0 ±1.0	20.4	Case	Black	ESD-R-25SD		X	–	700L
ESD-R-25D-1	26.0 ±1.0	14.0 ±1.0	15.0 ±1.0	21.0	Case	Black with yellow tape	ESD-R-25SD		X	–	700L
ESD-R-38	39.0 ±0.8	17.5 ±0.8	14.0 ±0.8	55.3	Case	White	ESD-R-38D	X		5H	–
ESD-R-38-1	39.0 ±1.0	17.5 ±1.0	14.0 ±1.0	56.0	Case	White with yellow tape	ESD-R-38D	X		5H	–
ESD-R-38C-1	39.0 ±1.0	17.5 ±1.0	14.0 ±1.0	55.5	Case	White with black tape	–		X	–	700L
ESD-R-38SA	39.0 ±0.8	17.5 ±0.8	14.0 ±0.8	56.0	Case	White	–	X		10H	–
ESD-R-47	48.0 ±1.0	25.5 ±1.0	16.0 ±1.0	84.4	Case	White	–	X		5H	–
ESD-R-47-1	50.0 Maximum	23.0 Minimum	18.0 Maximum	90.0	Case	White with yellow tape	ESD-R-47S	X		5H	–
ESD-R-47D-1	48.0 ±1.0	25.5 ±1.0	16.0 ±1.0	84.6	Case	White with black tape	–		X	–	700L
ESD-R-57	61.0 Maximum	32.4 ±1.0	24.0 Maximum	150.1	Case	White	–	X		5H	–
ESD-R-57A-1	61.0 Maximum	32.4 ±1.0	24.0 Maximum	150.1	Case	White with yellow tape	ESD-R-57S	X		5H	–
ESD-R-57D-1	61.0 Maximum	32.4 ±1.0	24.0 Maximum	154.2	Case	White with black tape	–		X	–	700L
Part Number	OD	ID	T	(g)	Type	Color	Compatible Toroid Core (Bare Type)	≤ 10 MHz (AM band range)	≤ 300 MHz (FM band range)	MnZn	NiZn
	Dimensions			Weight				Frequency Range <sup>1</sup>		Material	

<sup>1</sup> Frequency range is for reference only. Please test with actual device before use.

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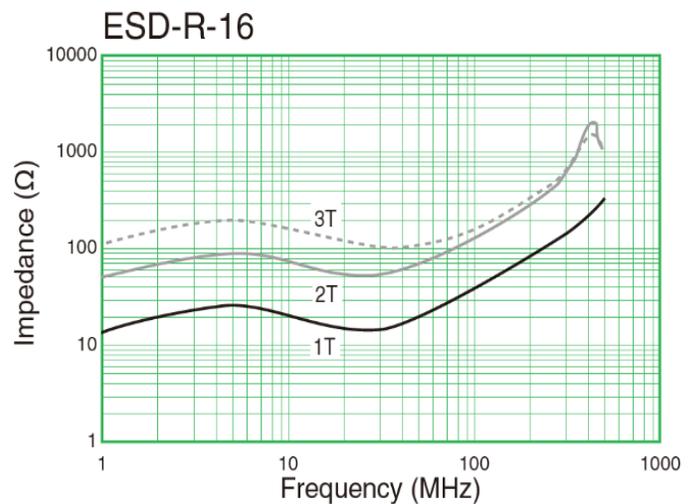
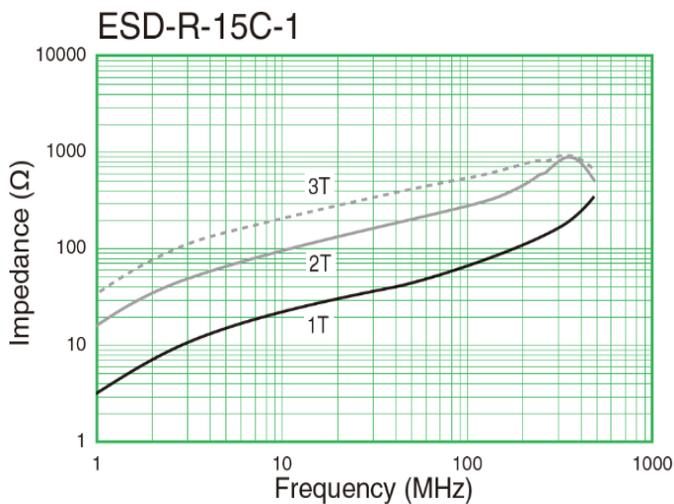
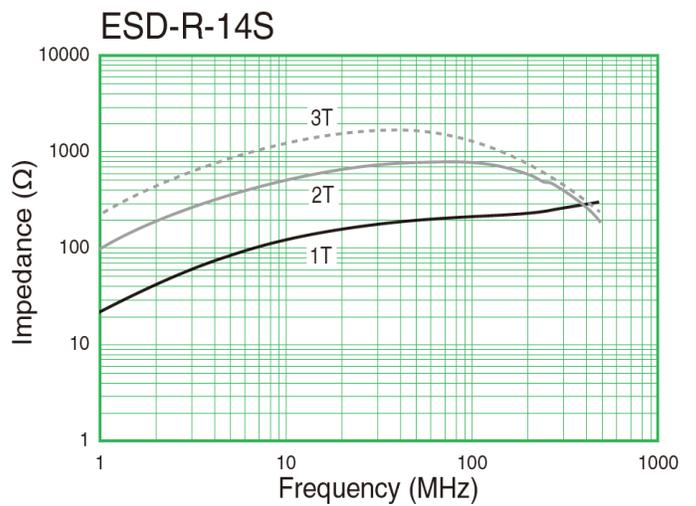
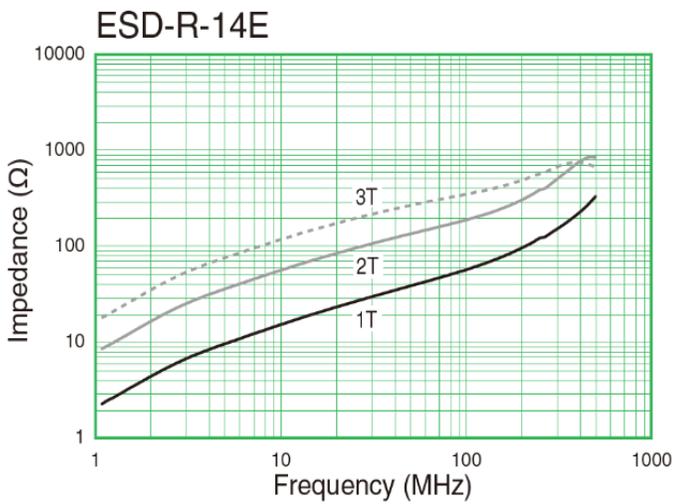
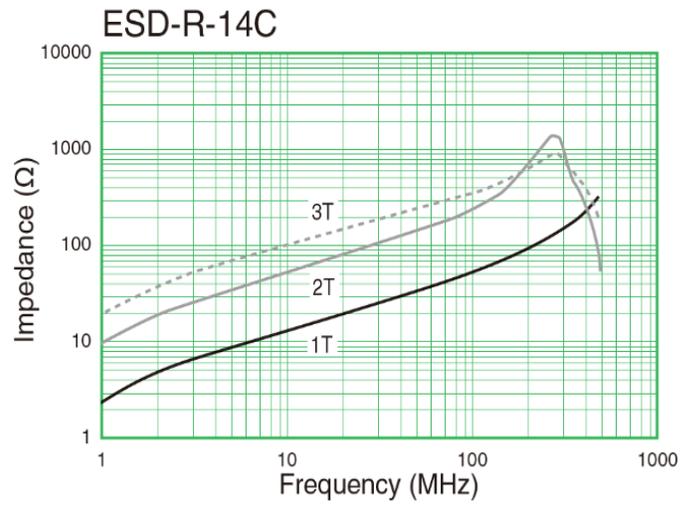
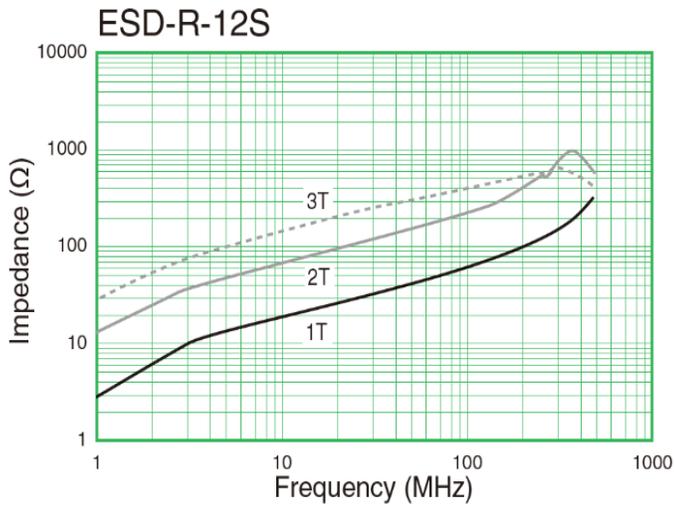
## Impedance vs. Frequency

Bare Type



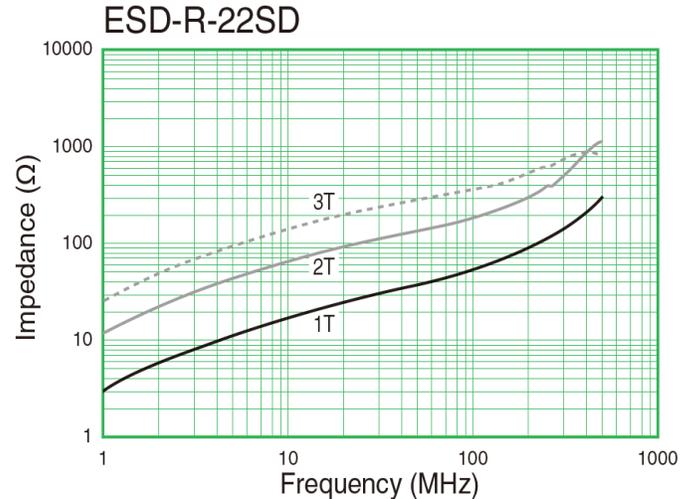
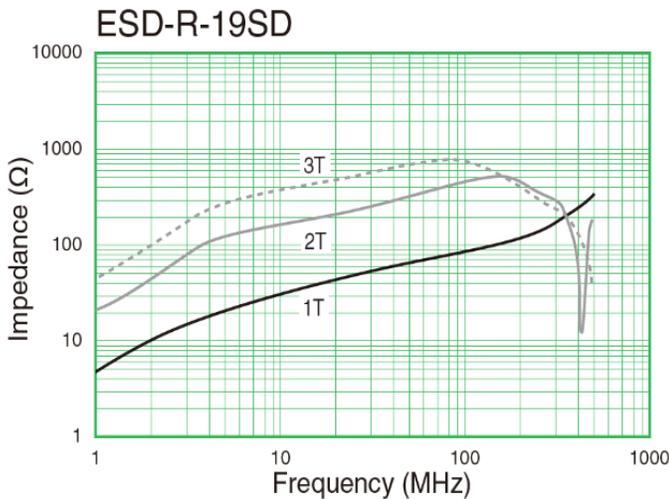
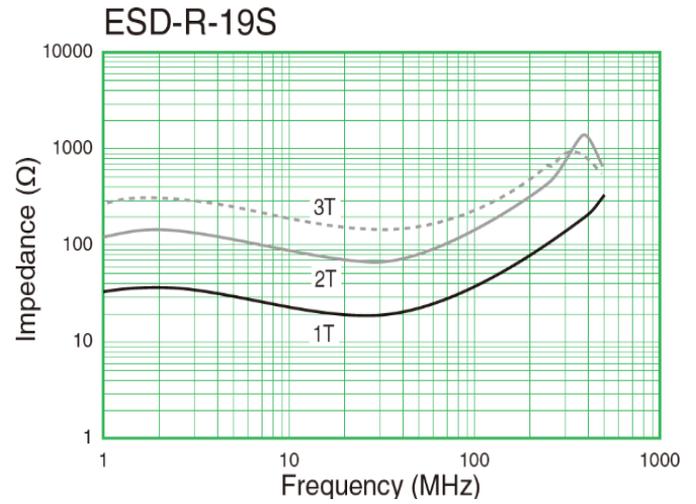
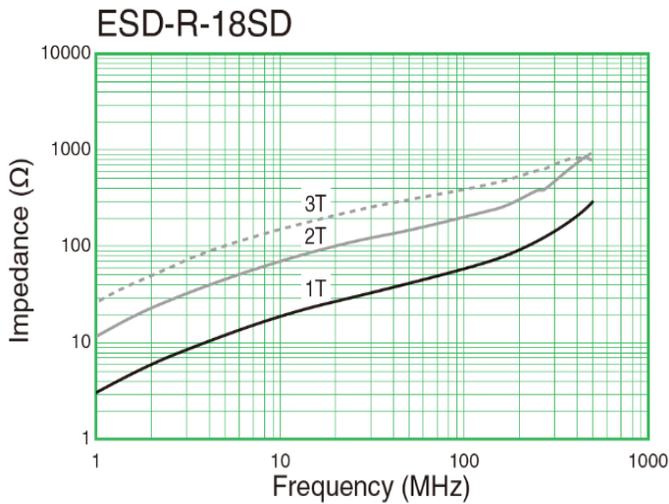
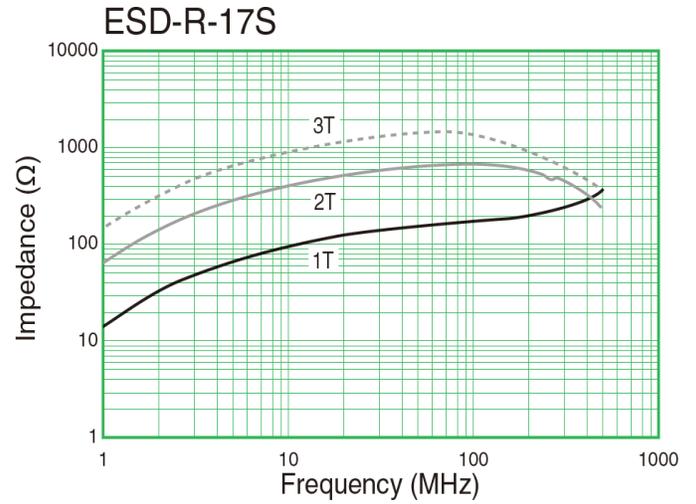
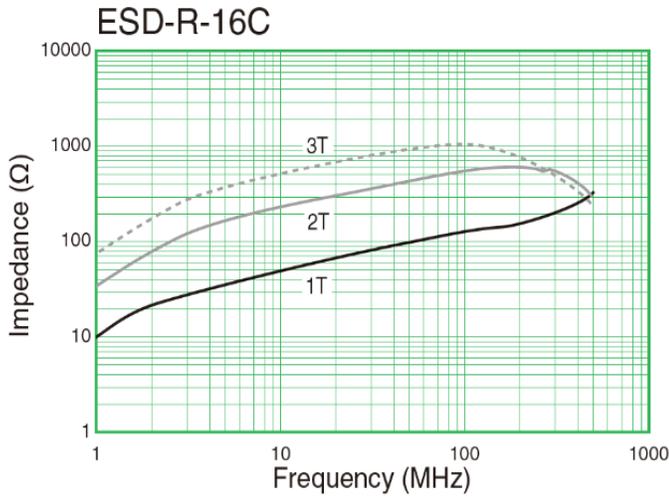
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Bare Type



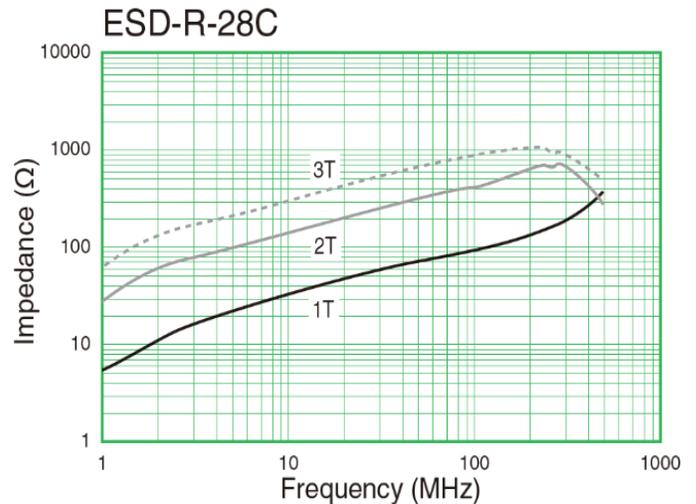
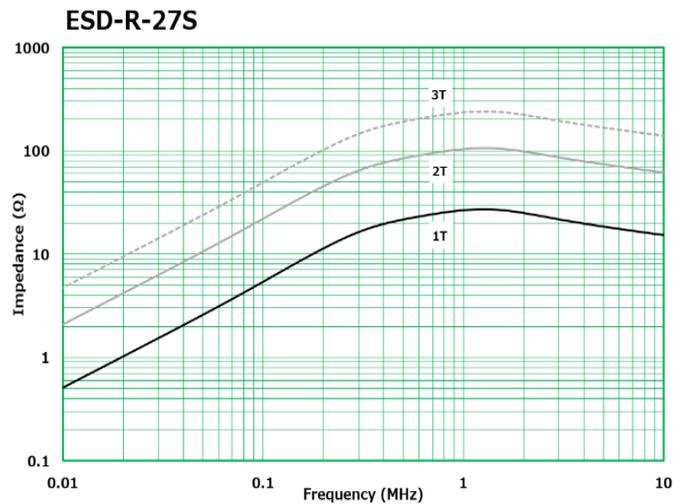
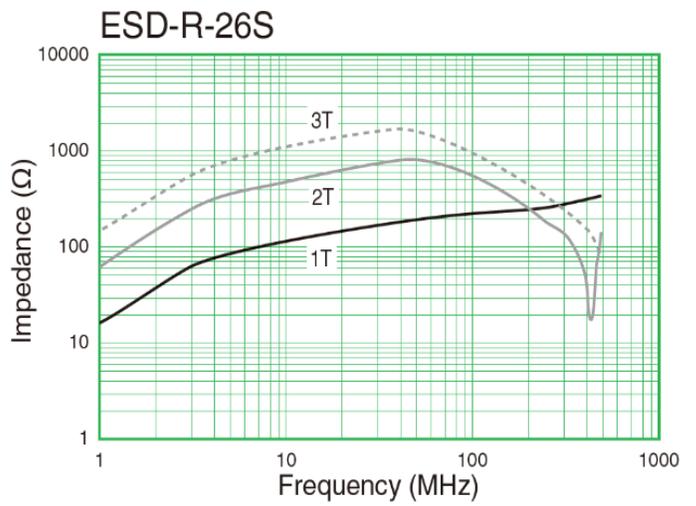
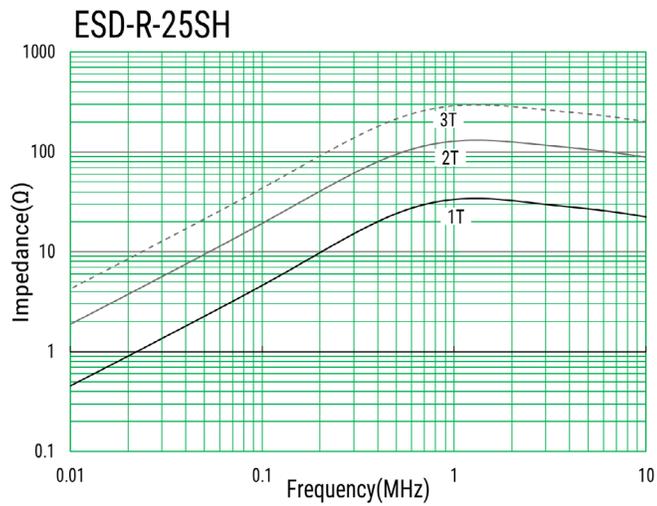
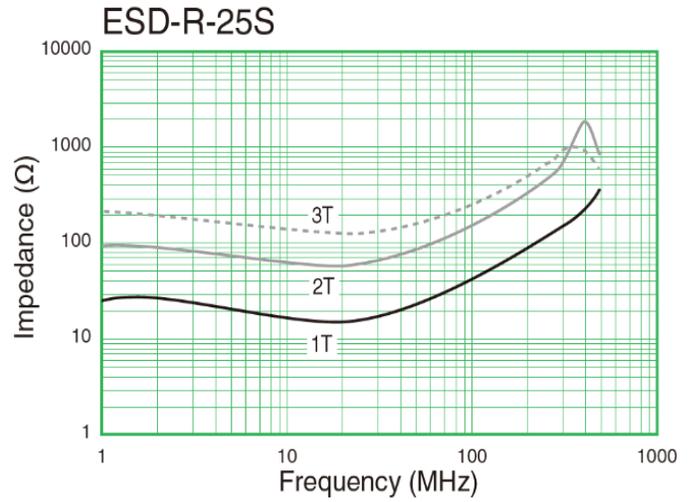
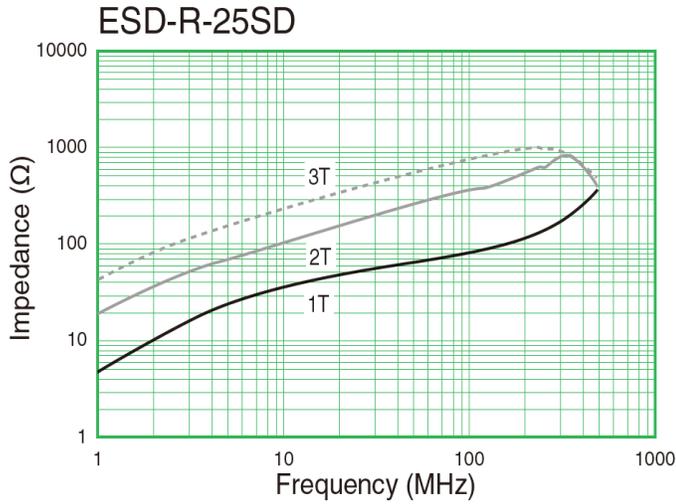
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Bare Type



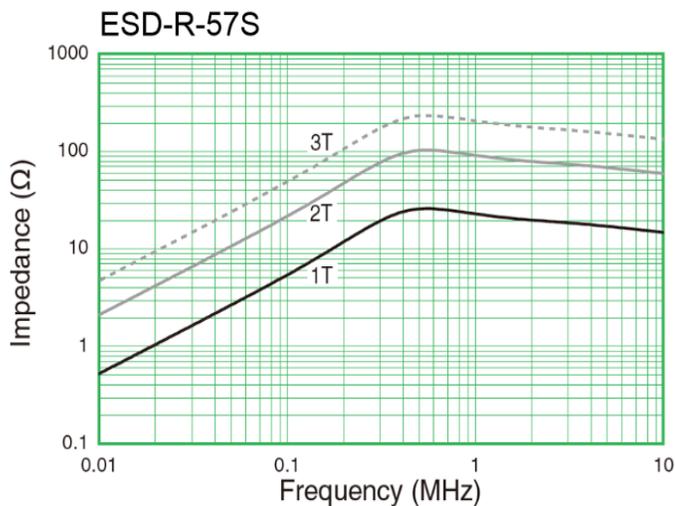
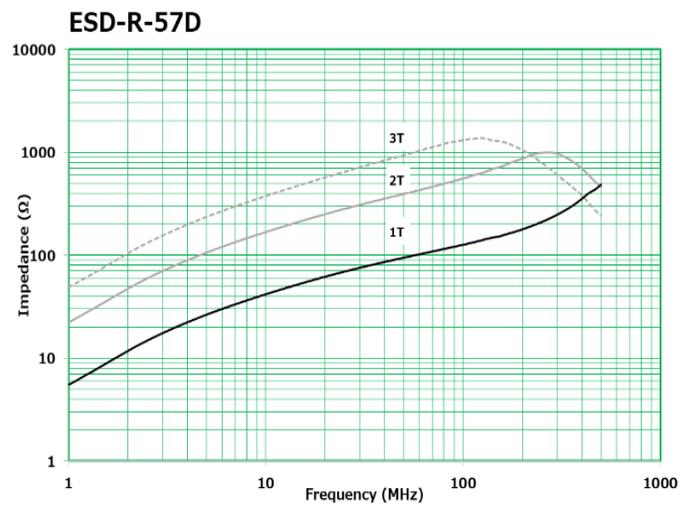
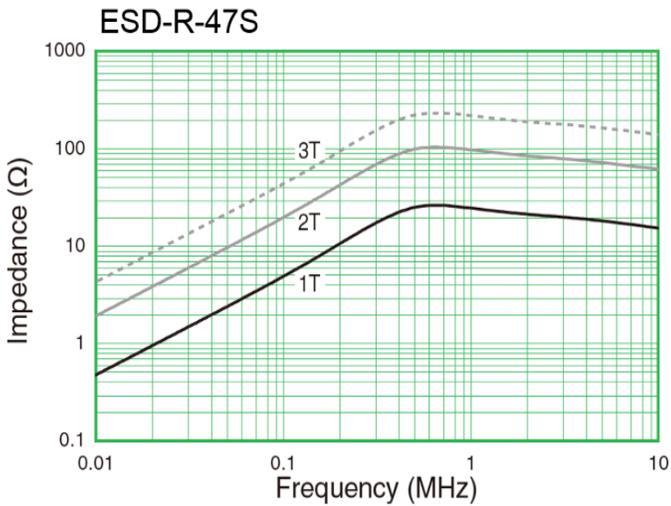
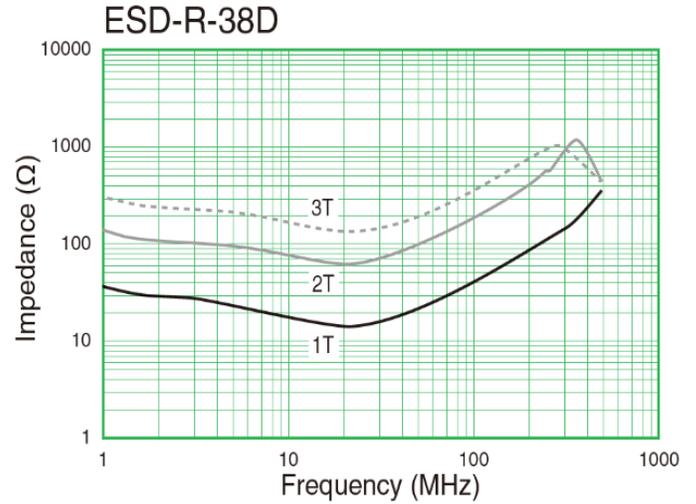
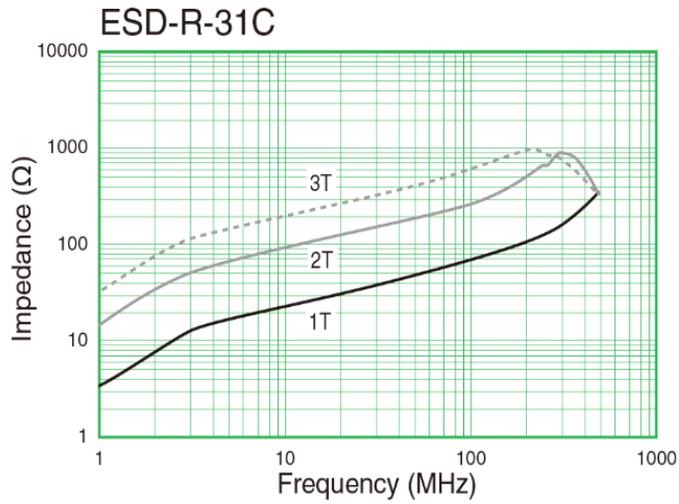
Impedance vs. Frequency cont.

Bare Type



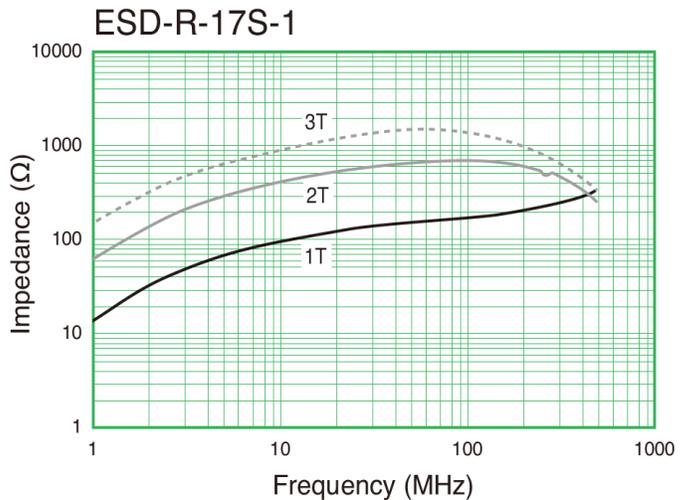
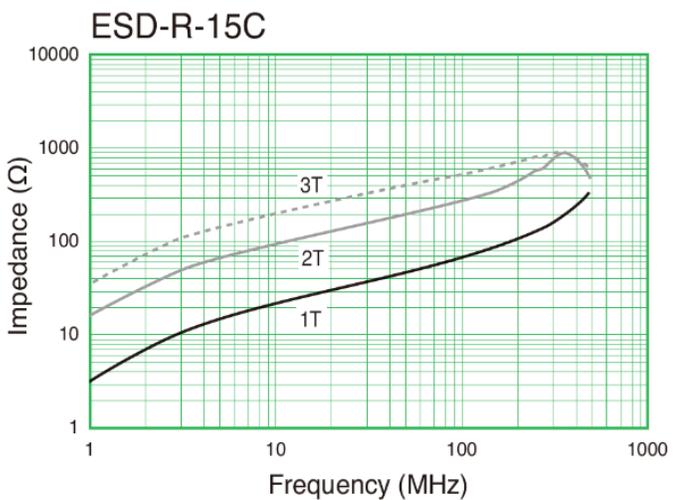
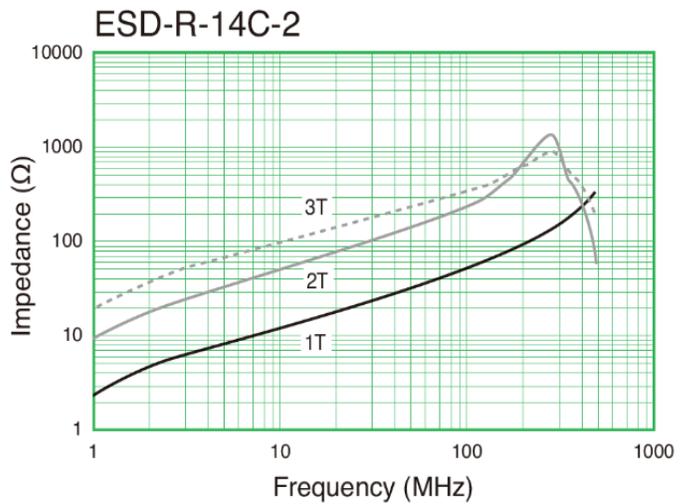
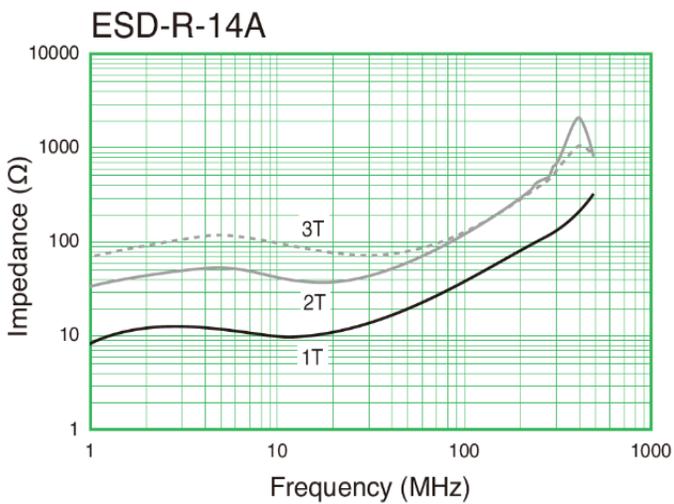
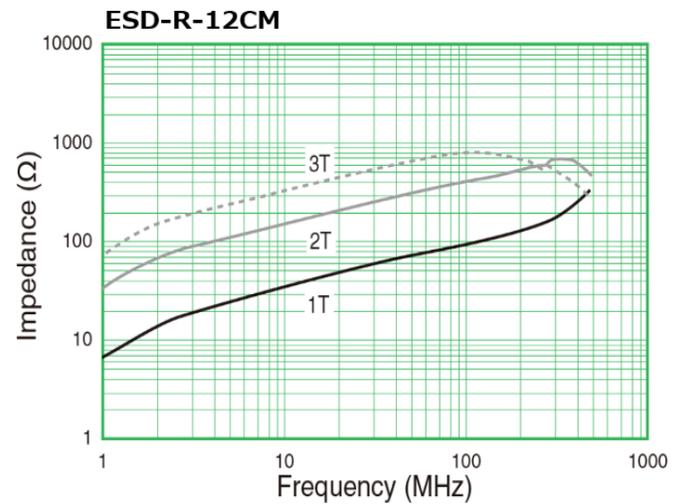
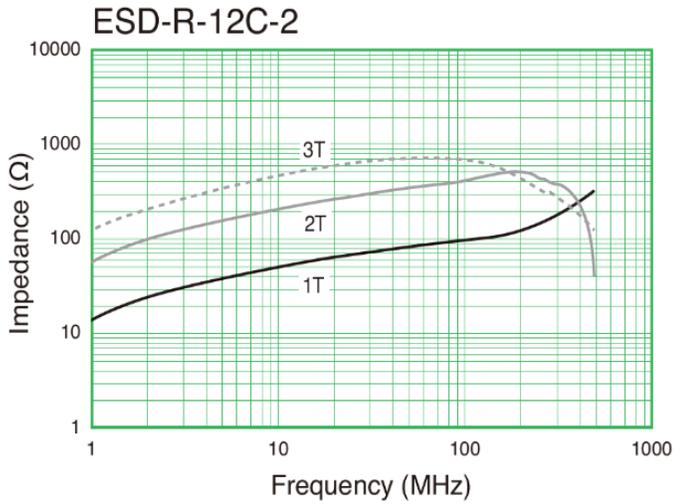
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Bare Type



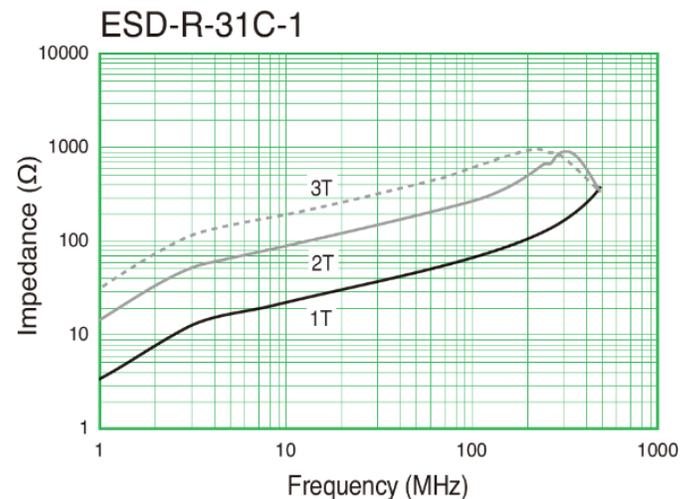
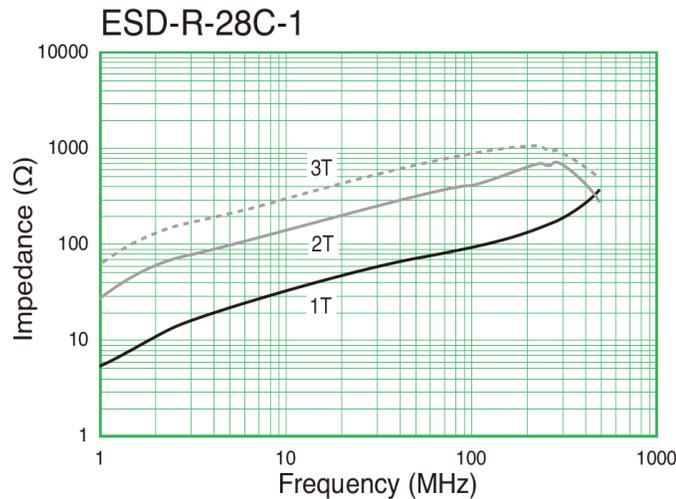
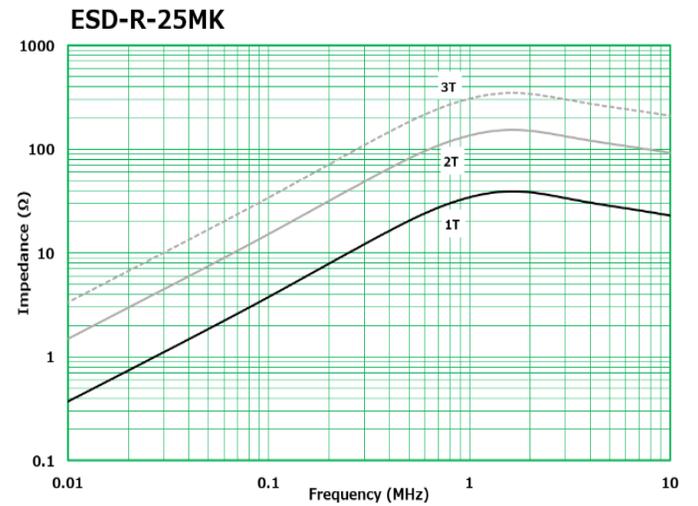
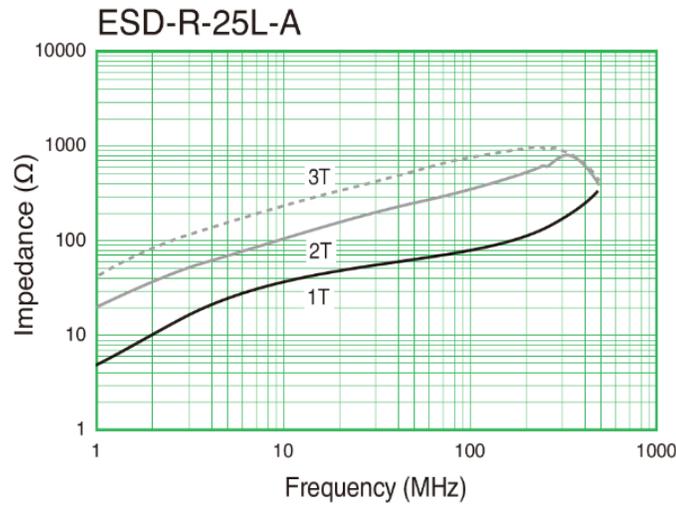
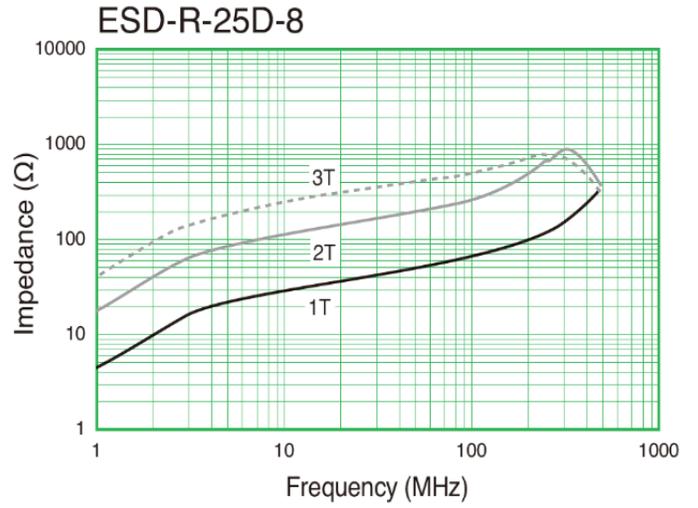
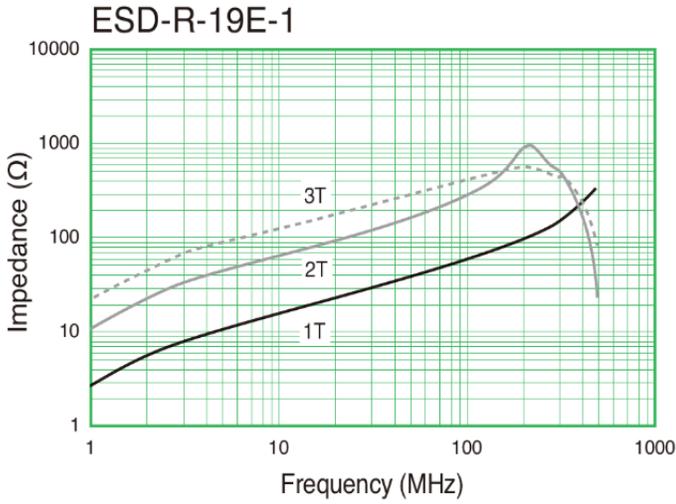
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Coated Type



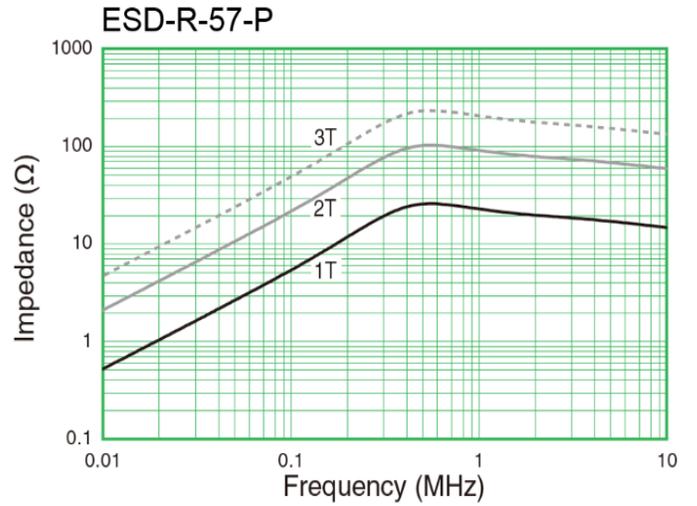
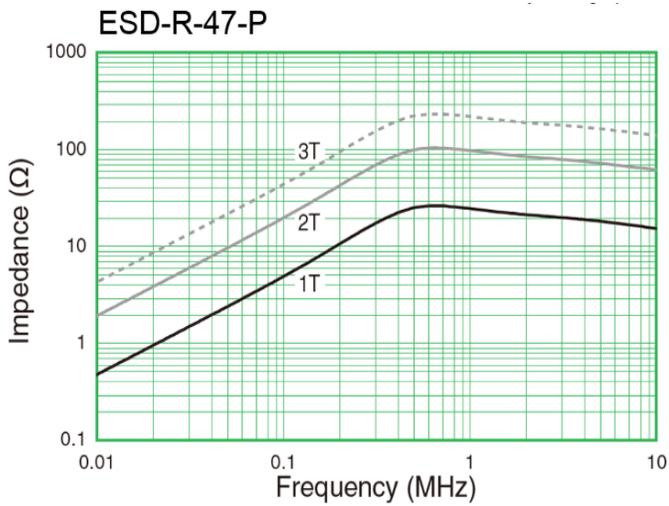
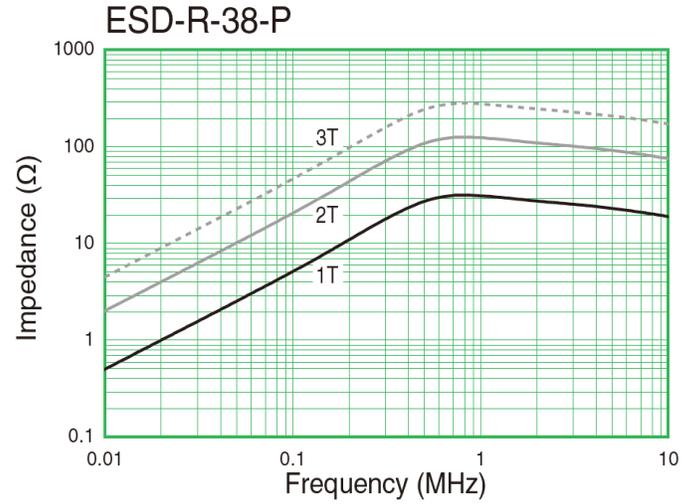
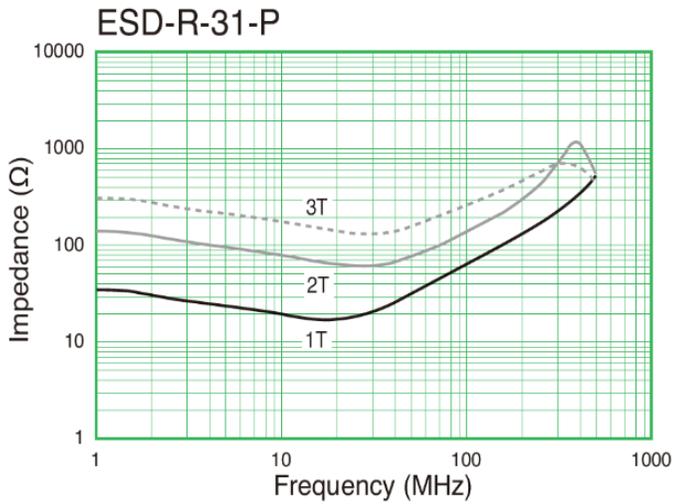
Impedance vs. Frequency cont.

Coated Type



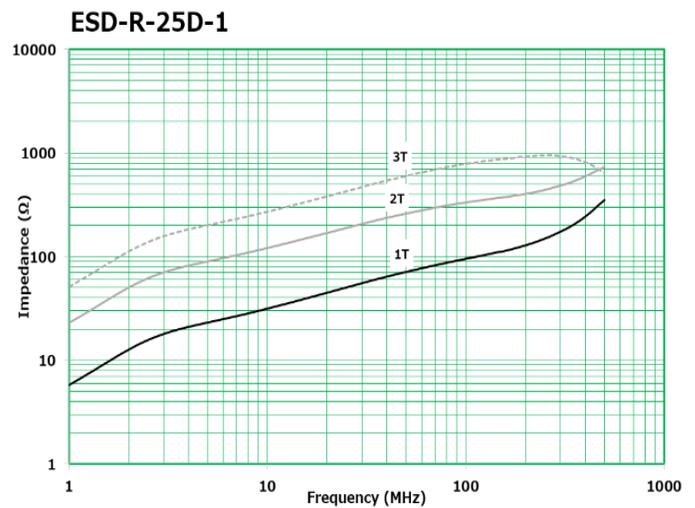
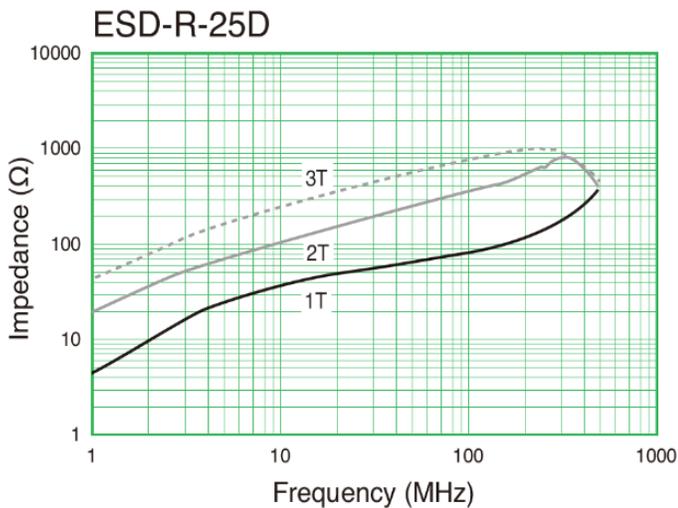
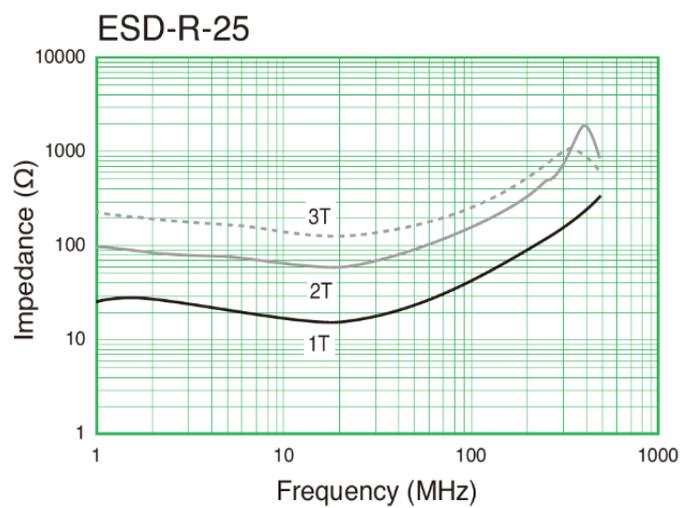
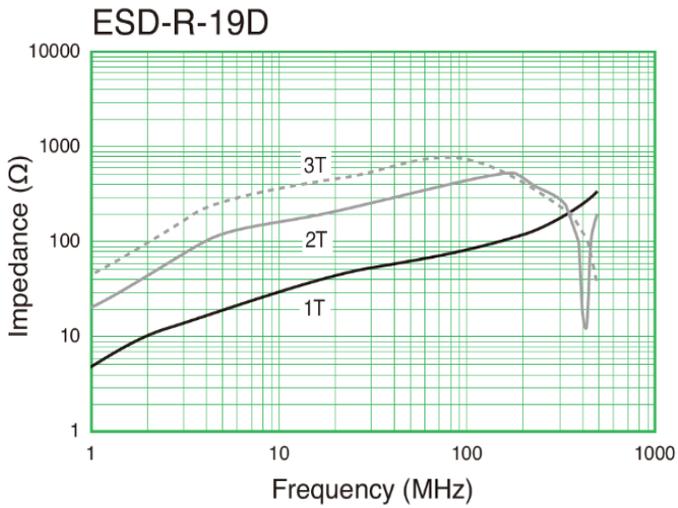
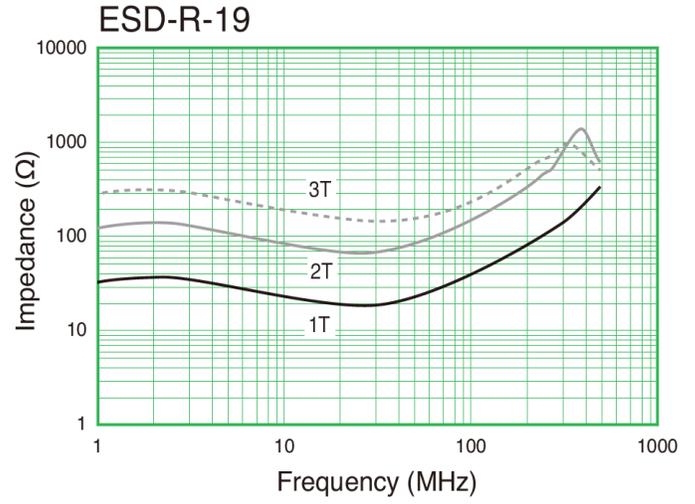
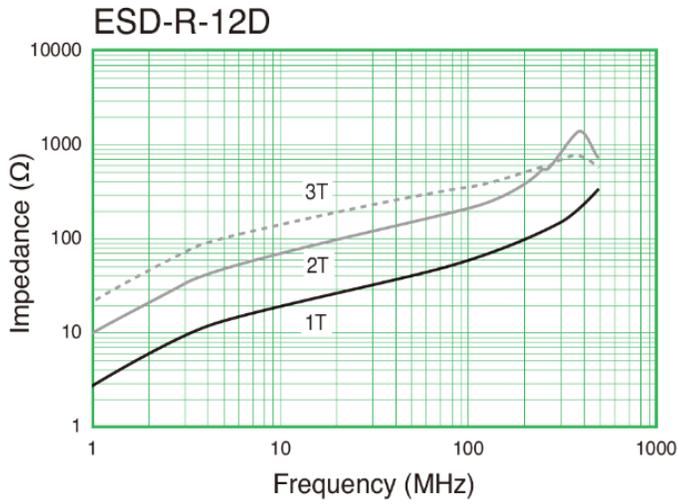
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Coated Type



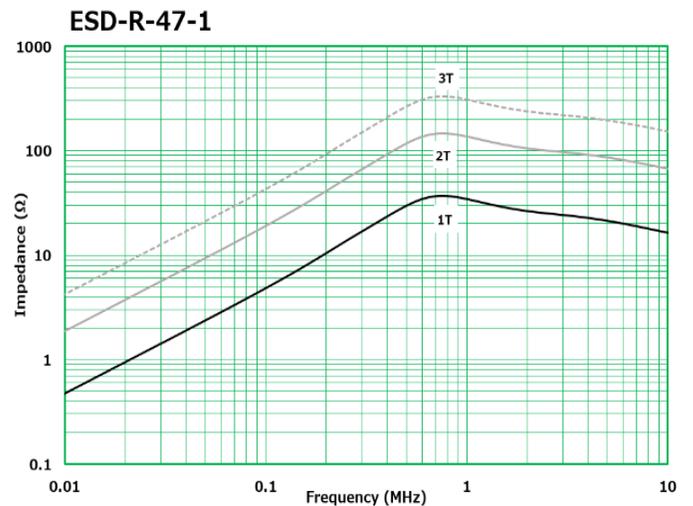
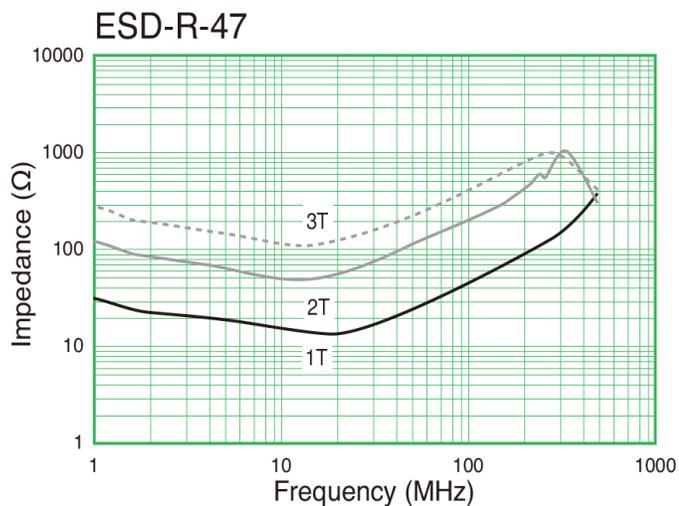
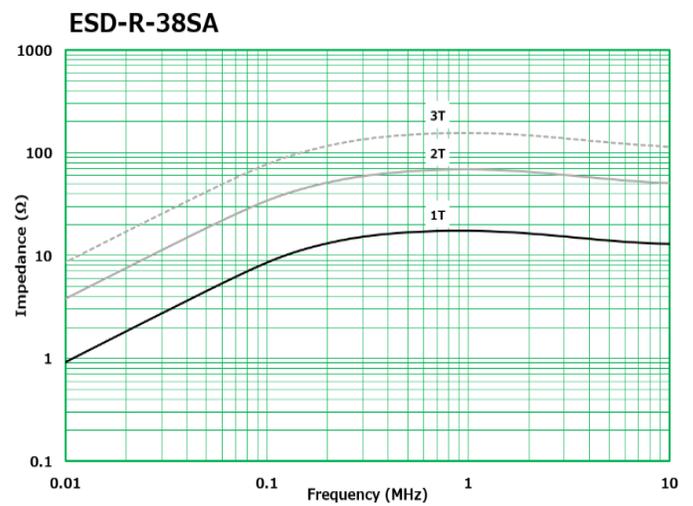
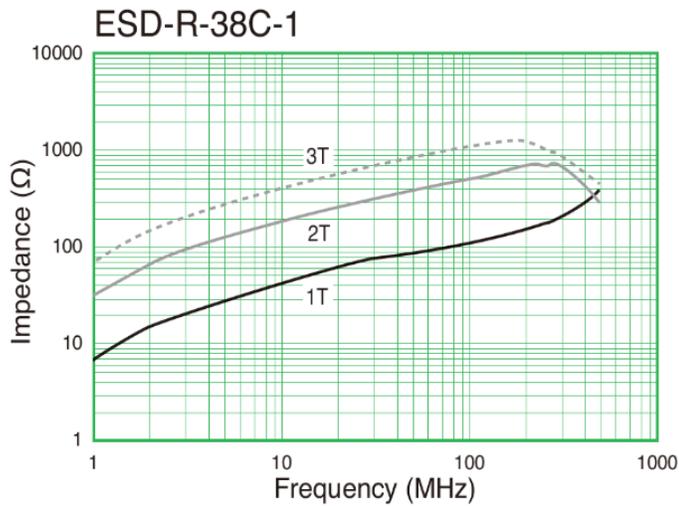
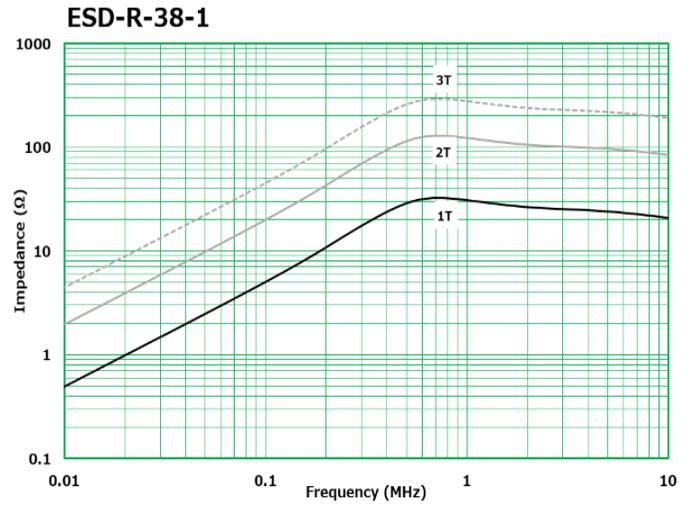
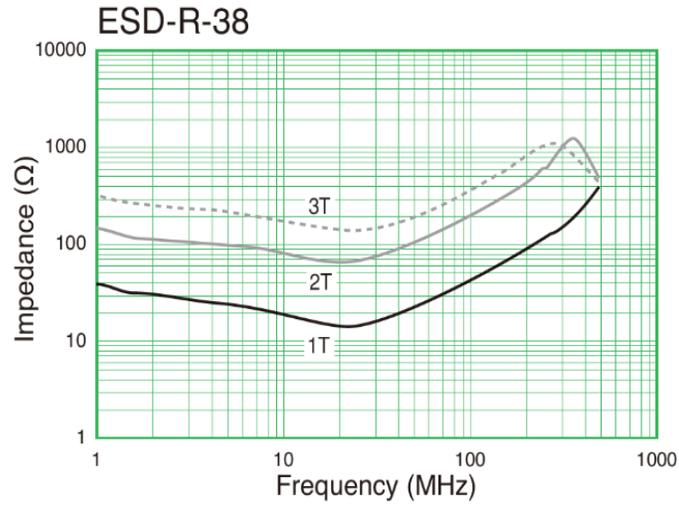
Impedance vs. Frequency cont.

Case Type



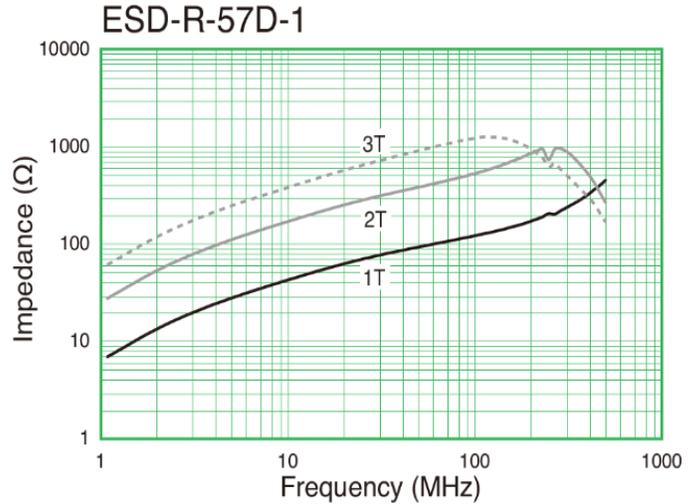
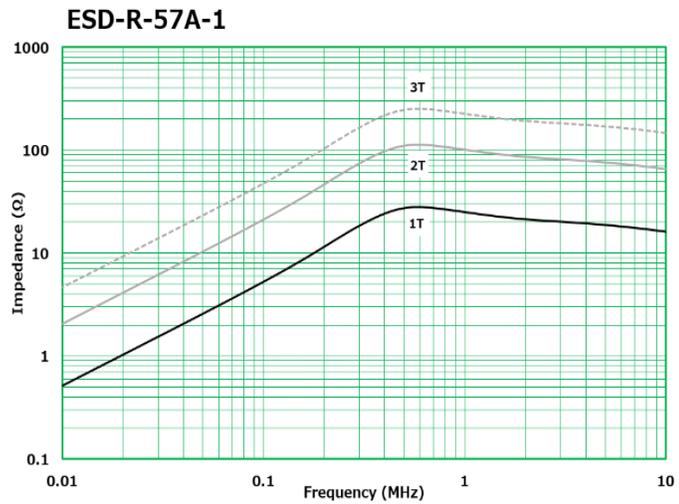
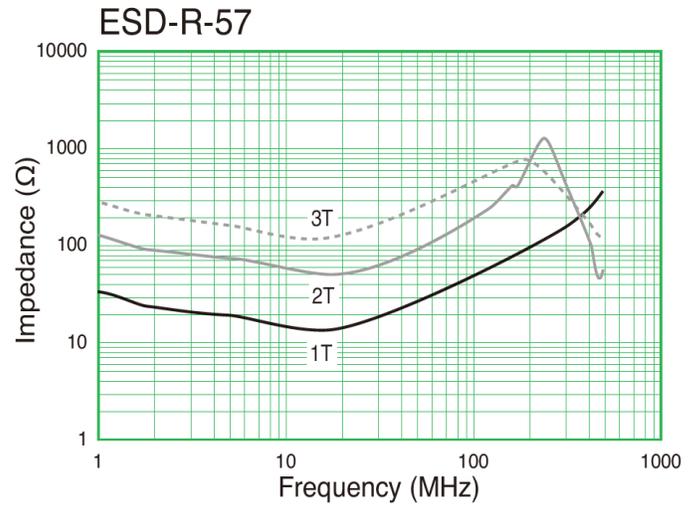
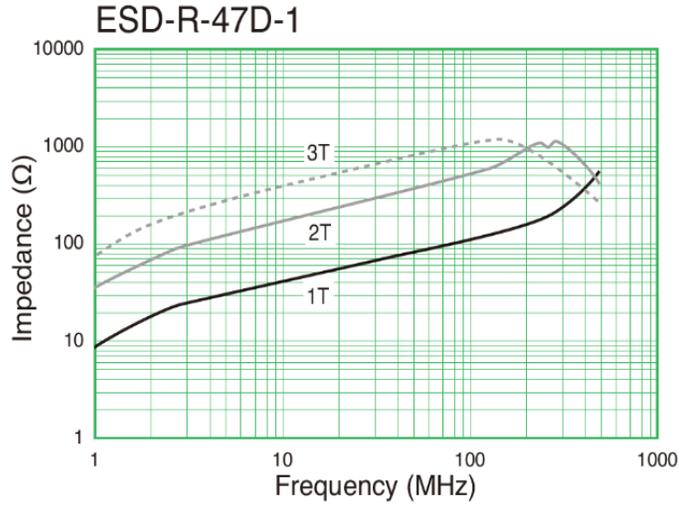
Impedance vs. Frequency cont.

Case Type



### Impedance vs. Frequency cont.

Case Type



## EMI Cores

### ESD-R Toroidal Cores for Round Cables for Low & High Frequency (Bare, coated & with case)

#### Packaging

Part Number	Packaging Type	Pieces per Box		
ESD-R-10D	Tray	3,600		
ESD-R-10E		7,000		
ESD-R-10S		1,260		
ESD-R-12C		1,400		
ESD-R-12E		1,500		
ESD-R-12F		1,400		
ESD-R-12S		1,500		
ESD-R-14C		Bulk	6,000	
ESD-R-14E	Tray	2,400		
ESD-R-14S		550		
ESD-R-15C-1		800		
ESD-R-16		780		
ESD-R-16C		720		
ESD-R-17S		440		
ESD-R-18SD		1,664		
ESD-R-19S		480		
ESD-R-19SD		1,120		
ESD-R-22SD		1,014		
ESD-R-25SD		540		
ESD-R-25S		300		
ESD-R-25SH		378		
ESD-R-26S		200		
ESD-R-27S		300		
ESD-R-28C			300	
ESD-R-31C			200	
ESD-R-38D		100		
ESD-R-47S		60		
ESD-R-57D		1,400		
ESD-R-57S		1,500		
ESD-R-12C-2		Bulk	6,000	
ESD-R-12CM			800	
ESD-R-14A			440	
ESD-R-14C-2			800	
ESD-R-15C			600	
ESD-R-17S-1			540	
ESD-R-19E-1			400	
ESD-R-25D-8			300	
ESD-R-25L-A			200	
ESD-R-25MK			100	
ESD-R-28C-1			Tray	300
ESD-R-31C-1				200
ESD-R-31-P	200			
ESD-R-38-P	100			
ESD-R-47-P				

## EMI Cores

### ESD-R Toroidal Cores for Round Cables for Low & High Frequency (Bare, coated & with case)

#### Packaging cont.

Part Number	Packaging Type	Pieces per Box
ESD-R-57-P	Tray	60
ESD-R-12D		2,000
ESD-R-19		480
ESD-R-19D		
ESD-R-25		300
ESD-R-25D		
ESD-R-25D-1		
ESD-R-38		200
ESD-R-38-1		
ESD-R-38C-1		
ESD-R-38SA		
ESD-R-47		100
ESD-R-47-1		
ESD-R-47D-1		
ESD-R-57		60
ESD-R-57A-1		
ESD-R-57D-1		

#### Handling Precautions

EMI Cores should be stored in normal working environments. While the EMI Cores themselves are quite robust in other environments, avoid exposure to high temperatures, high humidity, corrosive atmospheres and long term storage for case, snap-on and split types.

KEMET recommends that maximum storage temperature not exceed 40°C and maximum storage humidity not exceed 75% relative humidity. Atmospheres should be free of chlorine, sulfur and alkali bearing compounds. Avoid also storage near strong magnetic fields as this might magnetize the product.

Temperature fluctuations should be minimized to avoid condensation or cracks on the parts. Mechanical shocks can bring to cracks as well.

## **KEMET Electronics Corporation Sales Offices**

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