EMI Cores

# ESD-R-B Toroidal Cores for Round Cables for Low & High Frequency (with snail-shaped case)

## Overview

The KEMET ESD-R-B series solid toroidal cores are designed to use on round cables. The wide range of Manganese Zinc (MnZn) and Nickel Zinc (NiZn) options allows for targeting of specific frequency ranges. The snail-shaped case allows fixing the core in the application to avoid contact with other components.

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

## Benefits

- MnZn ≤ 10 MHz (AM band range) and NiZn ≤ 500 MHz (FM band range) options available
- Solid construction
- Easy to install with one M4 screw
- UL94 V–2 flame retardant rated case

## Part Number System

| ESD- | R- | 19 | B |
|---|---|---|---|
| Series | Shape Type | Core Size<br>Outer Dimension Code (mm) | Core Material |
| ESD- | Ring | See Table 1 | B = Mn-Zn<br>D-B = Ni-Zn |

## 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*

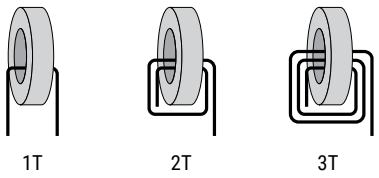
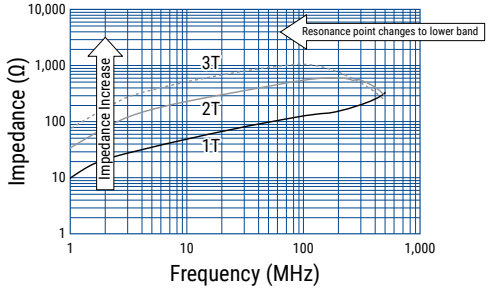



*Figure 2 – Relationship between impedance and turn count. (Representative example: ESD-R-16C)*



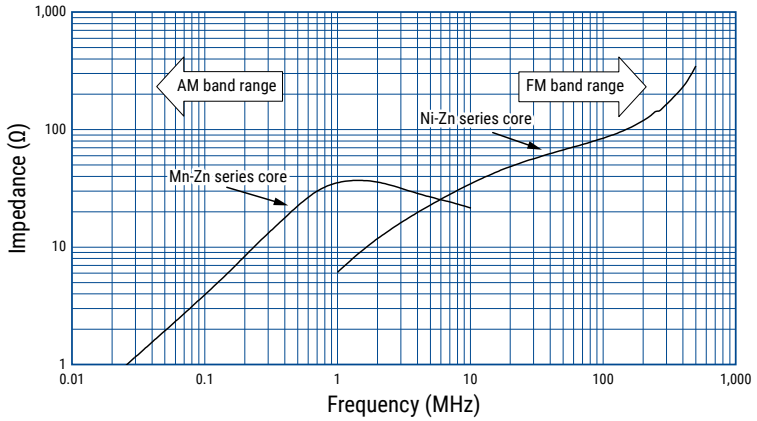

## Core Material and Effective Frequency Range

There are two ferrite material options for KEMET EMI Cores: Nickel Zinc (Ni-Zn) and 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 Ni-Zn core material is typically effective for frequencies in the MHz band range such as the FM-band, while the Mn-Zn core material is typically effective for the kHz band range such as the AM-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 material. (Representative example, measured with same-dimension ring core)*



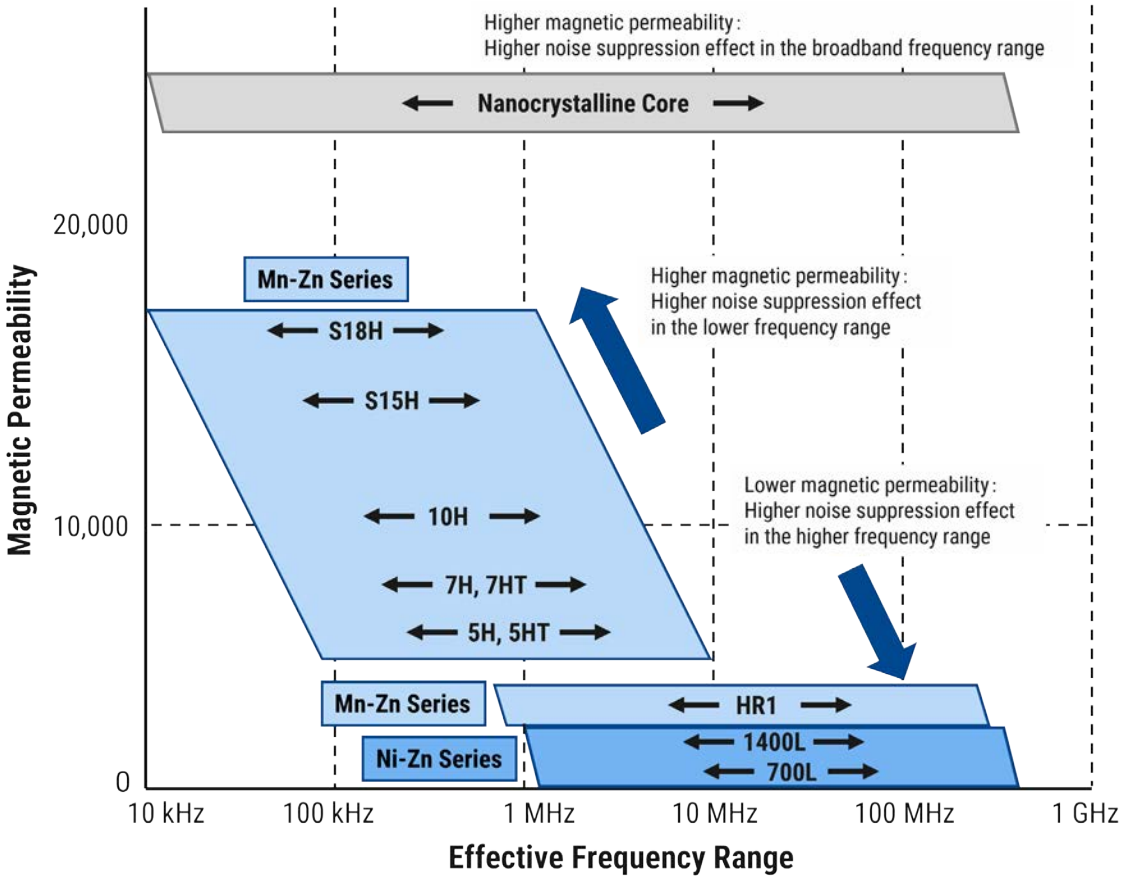
## Magnetic Permeability of Ferrite Material

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.

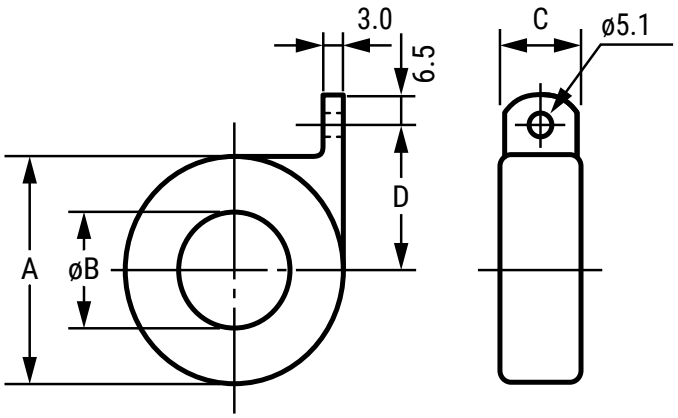
*Figure 4 - Relationship between the magnetic permeability of each material and its effective frequency range*



## Environmental Compliance

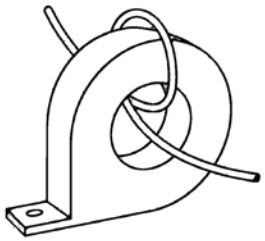
All KEMET EMI cores are RoHS compliant.

## Dimensions – Millimeters




*See Table 1 for dimensions*

## Installation Example



## Performance Characteristics

| Item | Performance Characteristics |
|---|---|
| Operating temperature | –25°C to +60°C |
| Frequency range | Low frequency and high frequency |
| Outer diameter | 21.5 – 51.5 mm |
| Inner diameter | 8.8 – 21.5 mm |
| Thickness | 13.0 – 17.5 mm |
| Type | Snail-shaped case |
| Case flame resistant rating | UL94 V–2 |
| Material | MnZn 5H and NiZn 700L |

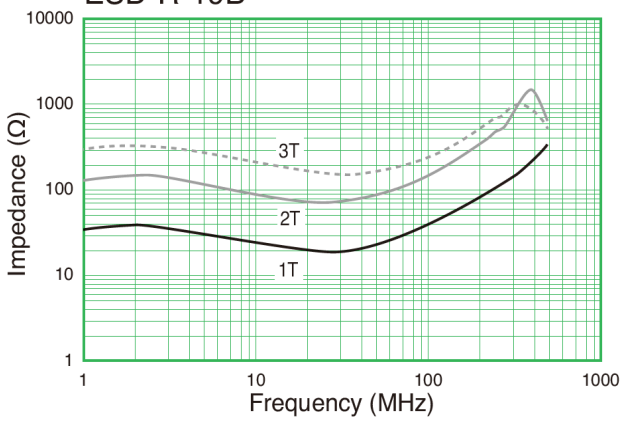
## Table 1 – Ratings & Part Number Reference

| Part Number | Dimensions (mm) | | | | Weight | Case Color | Compatible Toroid Core (Bare Type) | Frequency Range[1] | | Material | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C Maximum | D | (g) | | | ≤ 10 MHz (AM band range) | ≤ 500 MHz (FM band range) | MnZN | NiZn |
| ESD-R-19B | 21.5 ±1.0 | 8.8 ±1.0 | 13.0 | 18.5 ±1.0 | 12.1 | White | ESD-R-19S | X | | 5H | – |
| ESD-R-19D-B | 21.5 ±1.0 | 8.8 ±1.0 | 13.0 | 18.5 ±1.0 | 11.7 | Black | ESD-R-19SD | | X | – | 700L |
| ESD-R-25B | 29.3 ±1.0 | 13.9 ±1.0 | 15.0 | 23.0 ±1.0 | 21.8 | White | ESD-R-25S | X | | 5H | – |
| ESD-R-25D-B | 29.3 ±1.0 | 13.9 ±1.0 | 15.0 | 23.0 ±1.0 | 21.8 | Black | ESD-R-25SD | | X | – | 700L |
| ESD-R-38B | 42.4 ±0.8 | 17.9 ±0.8 | 16.0 | 28.0 ±0.8 | 58.6 | White | ESD-R-38D | X | | 5H | – |
| ESD-R-38D-B | 42.4 ±1.0 | 17.9 ±1.0 | 16.0 | 28.0 ±1.0 | 58.6 | Black | – | | X | – | 700L |
| ESD-R-47B | 51.5 ±0.7 | 25.5 ±0.7 | 17.5 | 34.0 ±0.7 | 89.0 | White | – | X | | 5H | – |
| ESD-R-47D-B | 51.5 ±0.7 | 25.5 ±0.7 | 17.5 | 34.0 ±0.7 | 89.0 | Black | – | | X | – | 700L |
| Part Number | A | B | C Maximum | D | (g) | Color | Compatible Toroid Core (Bare Type) | ≤ 10 MHz (AM band range) | ≤ 300 MHz (FM band range) | MnZn | NiZn |
| | Dimensions | | | | Weight | | | Frequency Range[1] | | Material | |

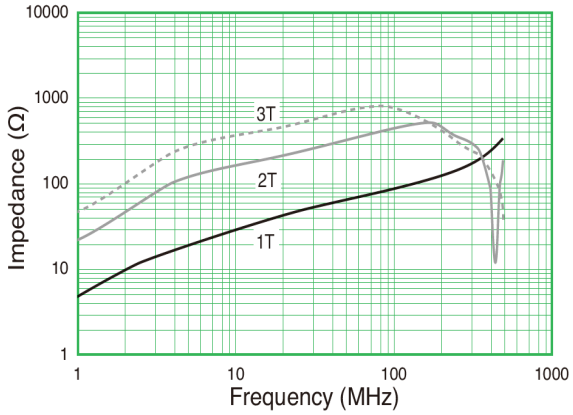
[1] *Frequency range is for reference only. Please test with actual device before use.*

## Impedance vs. Frequency

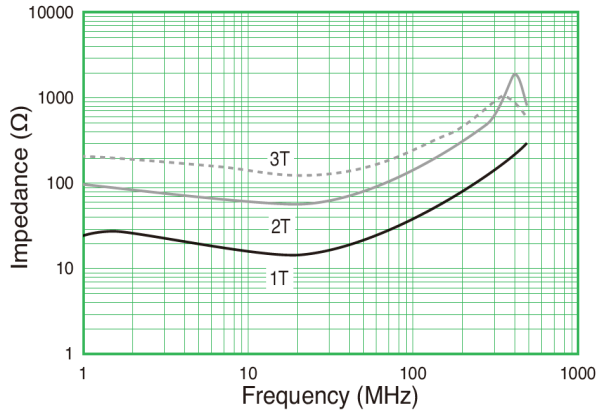
ESD-R-19B



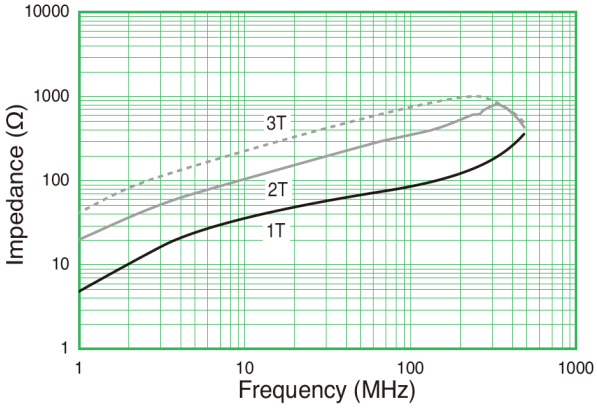

ESD-R-19D-B



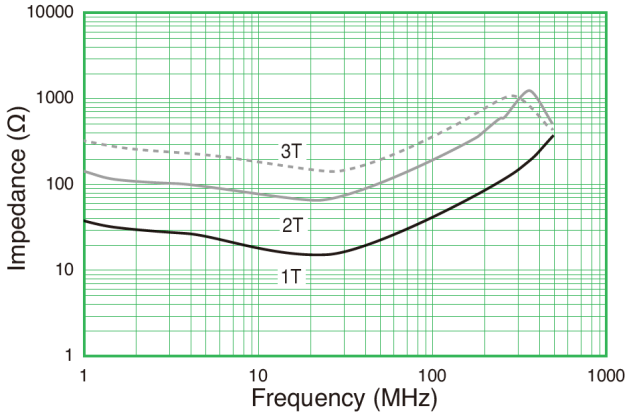

ESD-R-25B



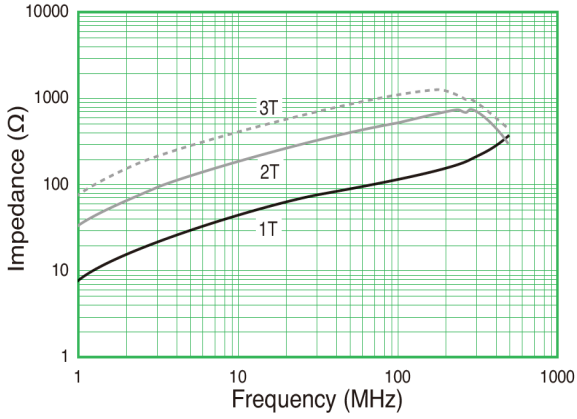

ESD-R-25D-B



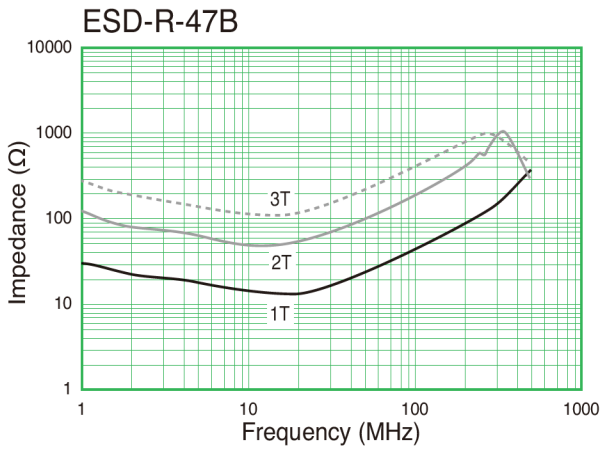

ESD-R-38B

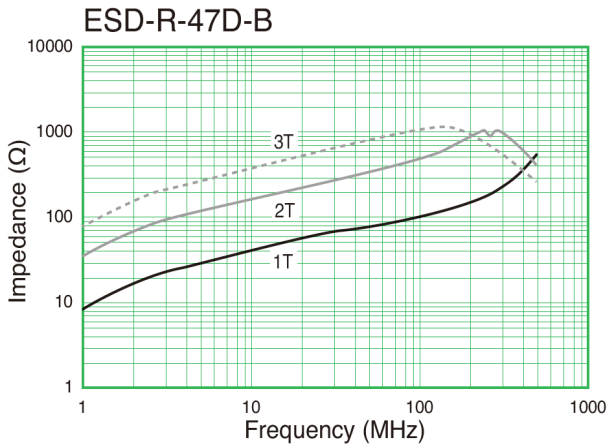



ESD-R-38D-B



## Impedance vs. Frequency cont.




## Packaging

| Part Number | Packaging Type | Pieces per Box |
|---|---|---|
| ESD-R-19B | Tray | 640 |
| ESD-R-19D-B | | |
| ESD-R-25B | | 300 |
| ESD-R-25D-B | | |
| ESD-R-38B | | 240 |
| ESD-R-38D-B | | |
| ESD-R-47B | | 90 |
| ESD-R-47D-B | | |

## 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.

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