

# Ferrite Cores for the Radio Frequency Identification (RFID) systems

(For antennas and shields)

### 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 brominebased flame retardants, PBB and PBDE, have not been used, except for exempted applications.

Sintered ferrite cores **RF series**  
 Ferrite powder **IR series**

The application of the Radio Frequency Identification (RFID) systems have been expanding in the van of the information utilization revolution that advances the barcode systems. TDK's original ferrite materials support the development of the devices for such advanced systems.



## RF series

**We have three material carefully selected for RFID in the lineup.**

The standard lineup includes three sintered ferrites with superb characteristics in the carrier-frequency band of each system as antenna core materials or subsidiary materials for improved antenna characteristics of RFID systems.

### Compatibilities of standard materials of RF series and RFID system frequency band

RF45 material of Ni-Zn type is compatible with the RFID system of 120-150kHz band and 13.56MHz band.

RF70 of Ni-Zn type and RF75 of Mn-Zn type are high  $\mu$  material optimized for the 120-150kHz band RFID system.

Composition system	Ni-Zn type		Mn-Zn type
	RF45	RF70	RF75
Material name			
Initial permeability $\mu_i$	230±25%*1	1300±25%*1	1800±25%*2
120-150kHz Band	●	●	●
13.56MHz Band	●	—	—

\*1. at 100kHz, 0.4A/m, 23±2°C \*2. at 1kHz, 0.4A/m, 23±2°C

### Original simulation technologies and rapid/inexpensive samples available

TDK provides support in designing RFID devices by accurately simulating electromagnetic environ-

ments based on a rich database, not to mention magnetic field analysis inside the core on designing new antenna cores, and improvements effecting evaluation of antenna characteristics at specific installation locations.

Samples can be provided quickly at an affordable price through a special technique which requires no metal molds.



## IR series

**Five different types of ferrite powder are also available.**

The standard lineup also includes a total of five ferrite powders consisting of high-permeability Mn-Zn materials, as well as high-resistivity Ni-Zn materials with grain sizes ranging from 8 $\mu$ m to 220 $\mu$ m. TDK also supports research and development of diverse materials for RFID (IR series).



# Three type of standard core shapes are available, supporting flexibly from large cores to small ones. Of course, diverse shaping processes such as windowing, incision processes, concavity and convexity shaping, and so forth are supported.

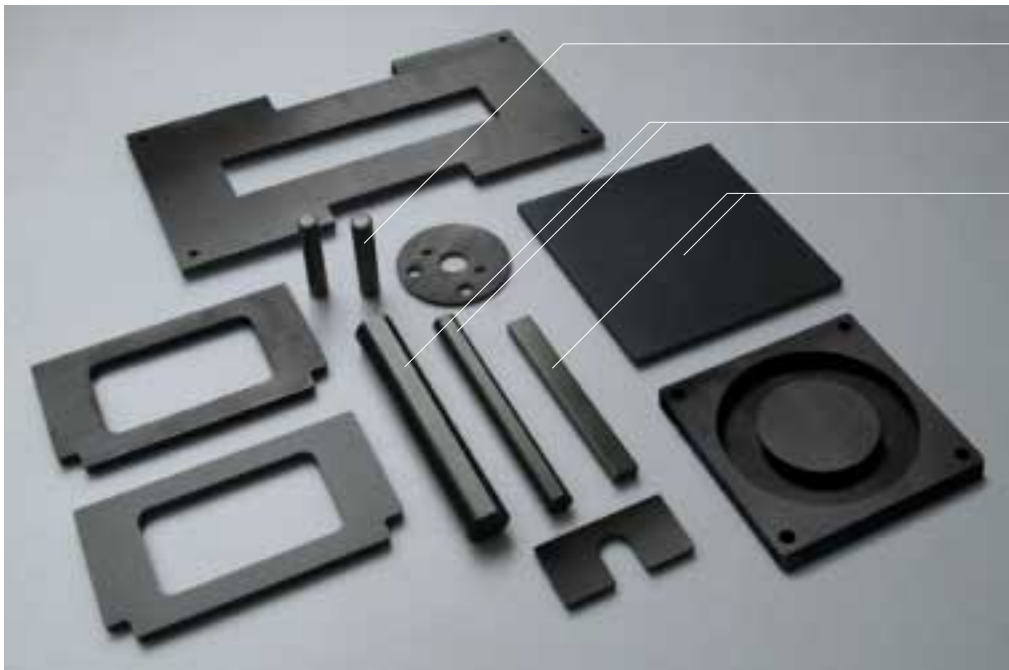
Requests for plate cores for large readers/writers will be satisfied by a one-piece casting process without bonding.

Each standard shape - SP(flat plate), R(cylinder), AR(cylinder + flat on both sides) is available for diverse needs regardless of size. As well as shaping incisions and openings, requests for diverse shapes, such as pots or plates with center poles, can be handled quickly and accurately by the advanced technologies and facilities.

RF, IR series



## Standard core shapes and representative examples of shape processing



- Standard R type**  
φ3mm min. / L200mm max.
- Standard AR type**  
φ6 to 22mm / L200mm max.
- Standard SP type**  
L250mm max.  
W155mm max.  
T20mm max.

The large plate-shaped cores processed with windowing and incision shown in the rear are designed for automatic ticket gate readers/writers. Of course, there are many more shapes than these examples. Diverse shapes and sizes such as complex window shapes, incision, concavity and convexity shaping are supported.

## Special shape cores and small cores are provided with optimal designs.



Not to mention standard shaped small cores such as the center pole and pot types, and so on, high-precision processing of complex three-dimensional shapes\*, which were difficult with sintered ferrite materials, is available through our original high-precision special crafting techniques.

\* The minimum size depends on the shape. Please contact TDK for details.

## Trend of needs for the ferrite cores for RFID systems

# TDK supports these advanced requirements with our superior ferrite core materials and high-precision processing technologies.

The communication range and identification ability of RFID is determined chiefly by the characteristics of the built-in antenna of the readers/writers and tags (transponders).

Ferrite cores are used in a wide range of applications for the built-in antenna of small transponder (RFID tag) integrated in automotive smart key systems, and attached to components and materials in production/distribution lines.

Also, with 120-150KHz band, 13.56MHz band RFID system reader/writer and the management information reading devices, loop-antenna units can not be installed if there are circuits or metal shields nearby\*. For that matter, ferrite cores are used effectively as a countermeasure to this limitation.

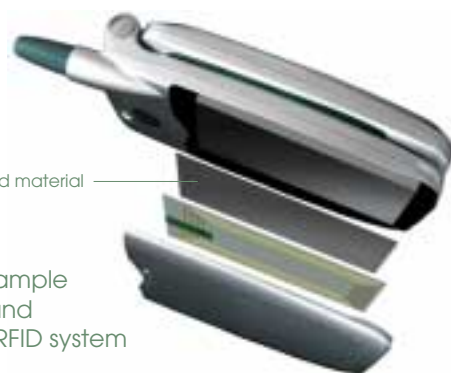
\*Eddy current induced on the metal surface creates reverse magnetic field, which cancels out the carrier waves(magnetic field), disturbing appropriate communication environment.

In addition to this, large loop antennas – 10cm on a side – which read information stored in the tags attached to packages and assembly components, sometimes have dead zones where the signal level decreases markedly in the communication range. In such cases, plate resin ferrites of a size similar to that of the antenna are attached to the back of the antenna as a countermeasure.

RF, IR series



Of course, maintaining antenna performance is a most important and basic theme in the latest efforts to integrate the 13.56MHz band RFID systems in small mobile devices such as mobile phones and PDA devices. Development of casing materials, sheet materials, and magnetic paint; the cores of ultra-small antenna which are not easily influenced by metal surfaces; and the magnetic shielding feature which shields super-thin sheet loop antennas from metals, has been accelerated.



### Representative material characteristic

Sintered ferrite sample: toroidal core (external diameter: 31mm; internal diameter: 19mm; height 8mm)

Composition system	Ni-Zn type	Ni-Zn type	Mn-Zn type
Material name	<b>RF45</b>	<b>RF70</b>	<b>RF75</b>
Initial permeability *1 $\mu_i$	230±25%	1300±25%	1800±25%
Saturation magnetic flux density *2 $B_s$ (mT)	420 (4kA/m)	280 (1.6kA/m)	510 (1194A/m)
Remanent flux density *2 $B_r$ (mT)	250 (4kA/m)	105 (1.6kA/m)	140 (1194A/m)
Coercive force *2 $H_c$ (A/m)	80 (4kA/m)	16 (1.6kA/m)	16 (1194A/m)
Curie temperature $T_c$ (°C)	250 min.	100 min.	200 min.
Volume resistivity *2 $\rho_v$ ( $\Omega \cdot m$ )	$10^5$ (at 23±2°C)	$10^5$ (at 23±2°C)	3 (at 23±2°C)
Powder density *2 $\rho_b$ (kg/m <sup>3</sup> )	$5.1 \times 10^3$	$5.0 \times 10^3$	$4.8 \times 10^3$

\*1. at 100kHz(RF15, RF45, RF70)or 1kHz(RF75), 0.4A/m, 23±2°C \*2. Average

# Offering selection of Ni-Zn, and Mn-Zn, by their advantages and characteristics according to the antenna design — this flexibility is a great strength in realizing slim, light, and low-cost "optimization".



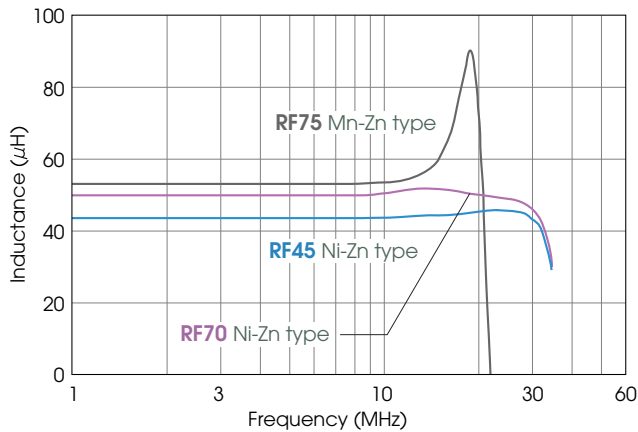
RF, IR series

## Frequency characteristic

Referential data

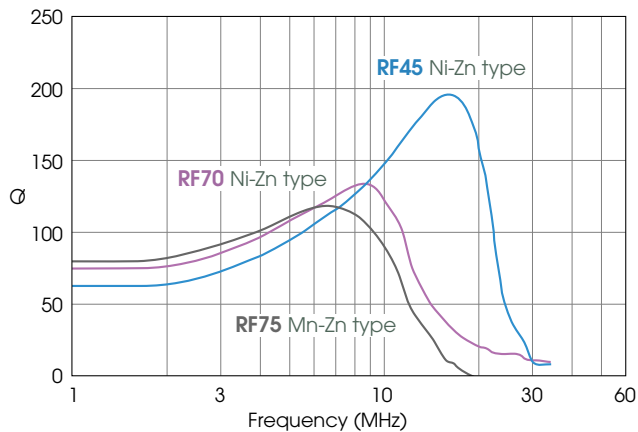
### Inductance vs. frequency characteristic

SP Core (100x14x3.8mm) / 30 ts



### Q vs. frequency characteristic

SP Core (100x14x3.8mm) / 30 ts



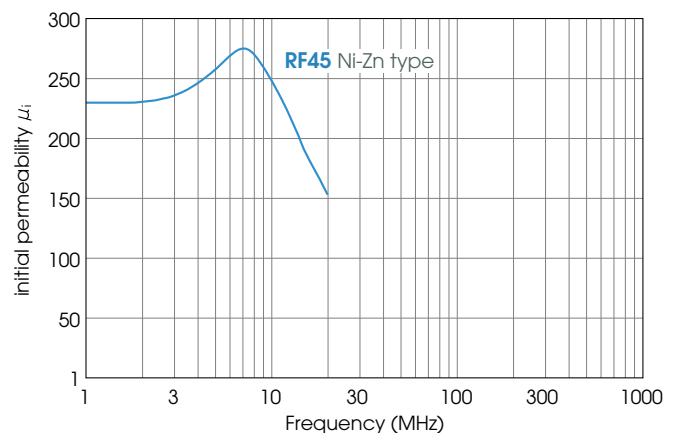
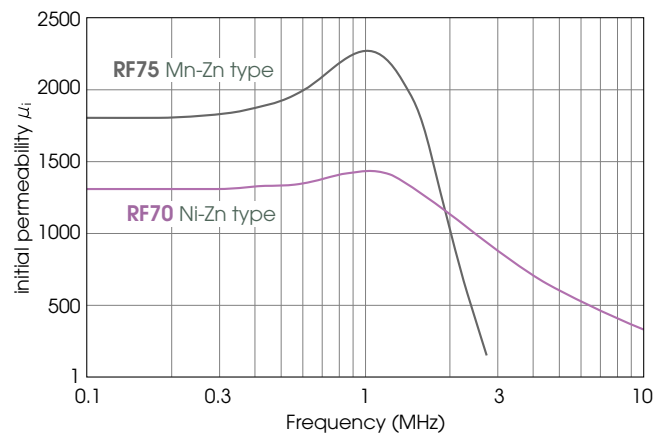
### $\mu_i$ vs. frequency characteristic

Sample: Toroidal core

External diameter: 31mm / Internal diameter: 19mm /

Height 8mm

at 0.4A/m, 23±2°C



# Five ferrite powder products through our original pulverization technologies are in the standard lineup, supporting diverse developments for reinforced RFID antenna characteristics.

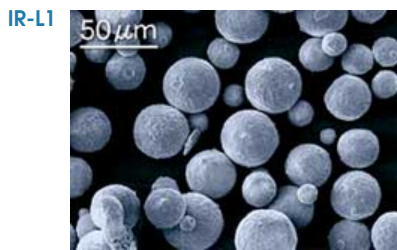


The ferrite powder developed through TDK's original pulverization technology is also available to support diverse efforts of the RFID antenna characteristics of small devices such as development of magnetic shield casing; research on magnetic paints; and filling void parts of the casing.

RF, IR series

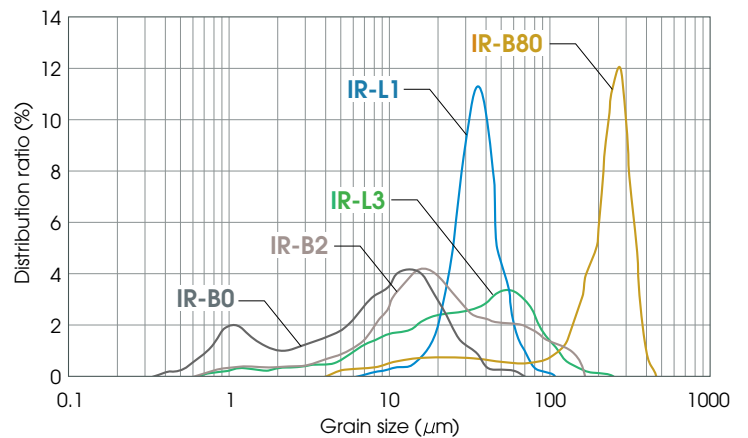


IR-B0



IR-L1

Distribution of grain sizes



## Material characteristic

### Representative example

Standard lineup includes five products using manganese-zinc high permeability materials and high-resistivity nickel-zinc materials with the grain size from 8 μm to 220 μm.

Composition system	Mn-Zn type			Ni-Zn type	
Grain shape	Infinite form			Spherical form	Infinite form
Material name	IR-B0	IR-B2	IR-B80	IR-L1	IR-L3
Average grain size (D50 μm)	8	18	220	34	25
Maximum magnetization* (A·m <sup>2</sup> /kg)	56.5	61.8	68.0	53.6	54.8
Curie temperature (°C)	200 min.	200 min.	200 min.	190 min.	110 min.
Volume resistivity (Ω·m)	3 typ.	3 typ.	3 typ.	10 <sup>5</sup> typ.	10 <sup>5</sup> typ.

\* at 80kA/m

## Information on related products



## Toroidal cores

for RFID impedance matching transformers

Your needs for toroidal cores - used in the impedance matching transformers of RFID readers/writers - will be met by a wide selection of materials and shapes.

### Supported shapes

Toroidal cores with external diameters between φ6 and φ80mm are available.

### Supported materials

Available in a wide selection of materials (Mn-Zn types, Ni-Zn types) covering initial permeability between 70 and 5500

■ Please contact us for details and technical documentation.