

ELCON

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TOROIDAL
CORES

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SPECIALITY MAGNETIC COMPONENTS

1. INTRODUCTION

Telcon high permeability strip wound toroidal cores are manufactured to the highest international standards, in a range of alloys and sizes developed to meet the most stringent specifications, and are used in a variety of applications.

The manufacturing processes, including core winding and final heat treatment, are carried out and controlled in-house. Cores are made on machines specially developed by Telcon, producing uniform precision components with high consistent stacking factors.

Telcon cores conform to the appropriate standard specifications and every core supplied is individually tested and guaranteed and, upon request, each despatch can be accompanied by a Certificate of Conformity.

2. GENERAL CHARACTERISTICS

Alloys:

Mumetal® type

M2, M2+

Supermumetal® type

SM2, SM150, SM200

Radiometal type

R36, R4550, SR

Square Loop

HCR

Example: for a core of dimensions 38mm OD x 25mm ID x 10mm H the cross-sectional area (A), if the core were solid, would be 65mm². When the core is wound from 0.10mm thick strip, the effective metal cross-section is 65mm² x 0.90 or 58.5mm².

Calculation formula:

$$A = H \times \frac{(OD - ID)}{2} \times SF \text{ mm}^2$$

Strip thickness

Cores are wound with the appropriate strip thickness from 0.013mm to 0.20mm to obtain optimum performance. At 50Hz, strip thickness of 0.20mm is commonly used, at 400Hz, strip thickness of 0.1mm is typical and for pulse applications thickness down to 0.013mm may be necessary.

Strip Insulation

The object in constructing high permeability cores from strip is to reduce the eddy current losses. Before fabricating the core, the strip is treated (Telcon Inlac® procedure) to prevent the eddy currents passing through from one layer to another.

Core Sizing

To calculate the metal cross-sectional area or weight, the solid values of these parameters must be multiplied by a stacking factor appropriate to strip thickness. Table 1 shows the nominal factors (SF) for various strip thickness. The following example indicates how the stacking factor is applied.

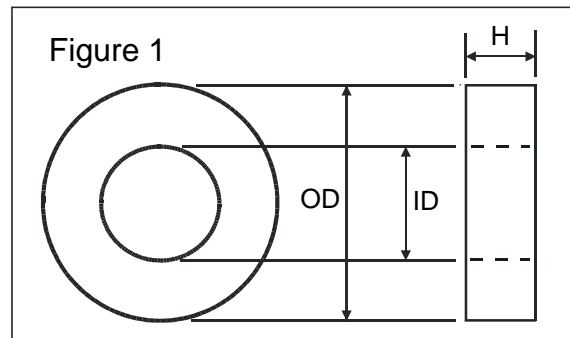


Table 1 – Stacking Factor (SF)

| Strip Thickness | Stacking Factor |
|-----------------|-----------------|
| 0.20 | 0.94 |
| 0.15 | 0.92 |
| 0.10 | 0.90 |
| 0.05 | 0.85 |
| 0.025 | 0.75 |
| 0.013 | 0.60 |

TELCON STRIP WOUND TOROIDAL CORES

3.1 Residual Current Detection (RCD)

Manufacture of high sensitivity residual current detection or earth leakage circuit breaker (ELCB), transformers requires the use of a M2 or SM150 or SM200 core. The main requirement in this area is for special sizes and thickness and Telcon manufactures cores to suit many specific customer designs where the key parameters of permeability and temperature stability require detailed control and measurement.

3.2 Radio Frequency Interference Suppression (RFI)

The technique of employing triacs to control AC power is extensively used in many industrial and consumer applications.

The control of AC power is effected by controlling the phase of each supply half cycle. Considerable interference voltages are generated in associated circuitry and the frequency spectrum of this contains harmonics in the long wave range of radio transmission.

Regulations governing the suppression of such interference are mandatory in many countries. Telcon cores comply with most specifications.

Telcon has developed a range of toroidal cores which are used for the manufacture of inductors suitable for suppressing interference and meeting the above regulations.

Suppression of interference in lamp dimmers, a typical application, is normally achieved by a combination of such an inductor **L** and capacitor **C** connected as shown in the circuit in figure 2 below.

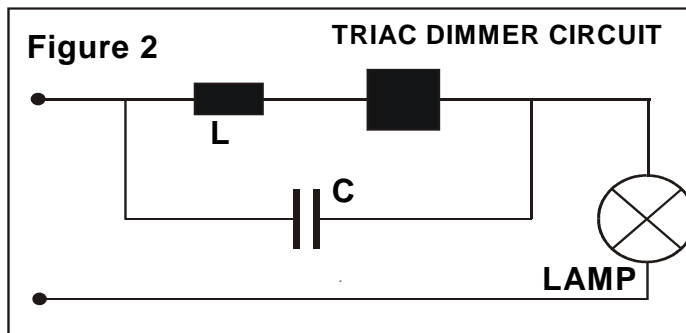


Table 2 – Standard coated RFI core sizes (mm)

| Type | Max.OD | Min.OD | Max.Ht | Power (W) at 240V | Turns | Capacitor value (μ F) | Flicker limit (W) |
|---------|--------|--------|--------|-------------------|-------|-----------------------------|-------------------|
| CM160 | 25.5 | 12.5 | 7.85 | 160 | 140 | 0.10 | 40 |
| CM160/8 | 25.5 | 12.5 | 9.5 | 250/400 | 130 | 0.15 | 40/60 |
| CM630 | 34.0 | 18.0 | 9.5 | 630 | 110 | 0.22 | 95 |
| CM1000 | 42.5 | 23.5 | 10.0 | 1000 | 120 | 0.22 | 150 |
| CM1600 | 45.5 | 26.5 | 14.5 | 1600 | 110 | 0.22 | 240 |
| CM2500 | 45.5 | 26.5 | 28.0 | 2500 | 85 | 0.22 | 375 |

In addition to supplying cores for the manufacture of chokes for radio frequency interference suppression, Telcon also offers complete ready wound RFI suppression chokes.

3.3 Microstrip Bobbins

A range of cores wound on ceramic bobbins is available, details on request.

TELCON STRIP WOUND TOROIDAL CORES

4. TYPICAL PROPERTIES OF NICKEL-IRON ALLOYS

Table 3

| | | M2 | M2+ | SM2 | SM150 | SM200 | R4550 | SR | R36 | HCR |
|--------------------------------------|-------------------------|---------|---------|---------|---------|---------|--------|---------|--------|---------|
| Initial permeability dc, $\mu_{0.4}$ | | 60 000 | 80 000 | 150 000 | 200 000 | 250 000 | 6 000 | 10 000 | 5 000 | 1 000 |
| Maximum dc permeability | | 240 000 | 280 000 | 350 000 | 375 000 | 400 000 | 40 000 | 100 000 | 30 000 | 100 000 |
| Saturation Induction, B_{sat} | Tesla | 0.77 | 0.77 | 0.77 | 0.77 | 0.77 | 1.6 | 1.6 | 1.2 | 1.6 |
| Remanence from saturation | Tesla | 0.4 | 0.45 | 0.45 | 0.45 | 0.45 | 1.0 | 1.1 | 0.5 | 1.5 |
| Coercivity H_c dc | A/m | 1.0 | 0.8 | 0.6 | 0.5 | 0.5 | 3.0 | 10 | 10 | 10 |
| Hysteresis Loss at B_{sat} | J/m ³ .cycle | 3.2 | 1.3 | 0.9 | 0.8 | 0.8 | 40 | 20 | 50 | 65 |
| Curie Temperature | °C | 350 | 350 | 350 | 350 | 350 | 450 | 450 | 280 | 450 |
| Density | kg/m ³ | 8800 | 8800 | 8800 | 8800 | 8800 | 8250 | 8250 | 8100 | 8250 |
| Resistivity | m Ω -m | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.45 | 0.4 | 0.8 | 0.4 |

The properties provided in this table are typical or average values for the basic material, unless otherwise stated, and are not a guarantee of maximum or minimum values obtained on wound cores.

5. CASES AND ENCAPSULATION

Nickel-Iron alloys are shock and stress sensitive and it is usual to provide mechanical protection in the form of a case or encapsulation for strip below 0.2mm thickness. A standard range of cores can be supplied in phenolic resin or thermoplastic protective cases. (See Table 4). Silicone grease or foam washers are included within the case to form an anti-vibration cushion.

However, where there are space limitations the cores can be supplied encapsulated in approximately 0.5mm thick epoxy resin with radiused edges. This will aid the subsequent application of copper windings and prevent any damage to the wire enamel insulation due to the sharp edges of the core. An alternative process of 'skin solidification' is available. This is a thin layer about 0.025mm thick, which is applied to the surface of the core. This makes the core rigid and easy to handle and greatly reduces the possibility of damage. Coating cores reduces the subsequent magnetic performance.

6. TYPICAL APPLICATIONS

- Interference Suppression
- Hall Effect Transducers
- Audio and High Frequency Transformers
- Magnetic Amplifiers
- Saturable Reactors
- Pulse Transformers

TELCON STRIP WOUND TOROIDAL CORES

7. STANDARD CORE & CASE SIZES (mm)

Table 4

| Type | Core O/D (mm) | Core I/D (mm) | Axial Length (mm) | Magnetic Length (mm) | Gross C. S. A.* (mm ²) | Weight of Solid Core (g) | Case O/D (mm) | Case I/D (mm) | Case Ht (mm) |
|-------------------|---------------|---------------|-------------------------------|----------------------|------------------------------------|----------------------------------|---------------|---------------|---------------------------------|
| 0a b | 15.90 | 12.70 | 3.17 6.35 | 44.90 | 5.00 10.10 | 1.99 3.99 | 18.03 | 10.79 | 5.18 8.38 |
| 1a b c | 19.10 | 12.70 | 3.17 4.76 6.35 | 49.90 | 10.10 15.10 20.20 | 4.44 6.63 8.87 | 21.21 | 10.79 | 5.18 6.78 8.38 |
| 2a b c | 22.20 | 14.30 | 4.76 6.35 7.94 | 57.40 | 18.90 25.20 31.50 | 9.55 12.70 15.90 | 24.38 | 12.37 | 6.78 8.38 9.96 |
| 3a b c | 28.60 | 19.10 | 4.76 6.35 7.94 | 74.80 | 22.70 30.20 37.80 | 14.90 19.90 24.90 | 31.24 | 16.64 | 7.32 8.89 10.46 |
| 4a b c | 33.30 | 22.20 | 6.35 7.94 9.52 | 87.30 | 35.30 44.10 52.90 | 27.10 33.90 40.60 | 35.99 | 19.81 | 8.89 10.46 12.04 |
| 5a b c | 38.10 | 25.40 | 6.35 9.52 12.70 | 99.80 | 40.30 60.50 80.60 | 35.40 53.10 70.70 | 40.89 | 22.99 | 8.89 12.07 15.24 |
| 6a b c d | 47.60 | 31.80 | 4.76 7.94 9.52 12.70 | 125.00 | 37.80 63.00 75.50 101.0 | 41.60 69.30 83.10 111.0 | 50.42 | 29.34 | 7.29 10.46 12.07 15.24 |
| 7a b c | 57.20 | 38.10 | 4.76 9.52 12.70 | 150.00 | 45.40 90.70 121.0 | 59.90 120.0 160.0 | 59.69 | 35.81 | 7.29 12.07 15.24 |
| 8a b c | 66.70 | 44.50 | 7.94 11.10 14.30 | 174.00 | 88.20 123.0 159.0 | 136.0 189.0 245.0 | 69.22 | 42.16 | 10.46 13.64 16.81 |
| 9a b c | 76.20 | 50.80 | 11.10 14.30 12.70 | 200.00 | 141.0 181.0 161.0 | 248.0 319.0 283.0 | 79.25 | 48.51 | 13.64 16.81 15.24 |
| 10a b c | 85.70 | 57.20 | 11.10 14.30 19.10 | 224.00 | 159.0 204.0 272.0 | 313.0 402.0 536.0 | 89.79 | 53.85 | 14.66 17.83 22.61 |
| 11a b c | 108.00 | 69.90 | 12.70 15.90 19.10 | 279.00 | 242.0 302.0 363.0 | 594.0 742.0 891.0 | 112.26 | 66.29 | 16.26 19.43 22.61 |
| 12a b c | 127.00 | 82.60 | 14.30 19.10 25.40 | 329.00 | 317.0 423.0 564.0 | 918.0 1230.0 1630.0 | 131.83 | 78.49 | 18.34 23.11 29.46 |
| 13a b c | 159.00 | 114.00 | 14.30 19.10 25.40 | 429.00 | 317.0 423.0 564.0 | 1200.0 1600.0 2130.0 | 163.58 | 110.24 | 18.34 23.11 29.46 |
| 14a b | 25.40 | 19.05 | 3.17 6.35 | 69.80 | 10.00 20.10 | 6.20 12.40 | 28.06 | 16.51 | 5.69 8.89 |

* Refer to Table 1 in Section 2

Cores in the range 0a – 5c are regularly produced, whereas cores in the range 6a – 14b can be manufactured to order, subject to our normal minimum order quantity.

TELCON STRIP WOUND TOROIDAL CORES



OTHER PRODUCTS

At the heart of our operations is a powerful and innovative design team able to take advantage of new developments in materials and processes.

The ranges described in this data sheet represent only a small part of the comprehensive product offered by the Company. Many products result from collaboration with users to meet the demands of a critical new application.

For comprehensive technical performance data, availability of custom-designed specials, and other products in the range, please contact our Product Managers who will be able to advise.

TELCON LIMITED
Old Brighton Road
Lowfield Heath
Crawley
West Sussex
RH11 0PR
UK

Tel: +44 1293 528800

Fax: +44 1293 524466

Email: sales@telcon.co.uk

Web: www.telcon.co.uk

Rev.1/08