

Square Loop Cores manufactured with cobalt-based METGLAS® amorphous alloy 2714A allow the design of mag amps that can operate at higher frequencies than previously possible. Their combination of magnetic properties enable magnetic amplifiers to provide unparalleled precision and efficiency in output regulation.

Mag amps are particularly well suited for outputs with currents of 1 amp to several tens of amps, although they are also used at lower currents where tight regulation and efficiency are extremely important.

Conventional regulated outputs are limited at higher frequencies and output currents. Linear regulators cannot handle output currents that exceed one or two amperes efficiently, and thus require heat sinking schemes, which increase the size of the power supply. Independent switched-mode sub-regulators avoid this inefficiency, but usually require circuitry which is more complex, expensive and less reliable than a mag amp.

*Standard sizes are available from 9.6 mm to 34.1 mm OD and the possibility of manufacturing custom sizes also exists. Core coatings meeting UL94V-0 and temperature class F are available upon request.*

#### Typical DC Hysteresis Loop METGLAS Alloy 2714A



METGLAS® Square Loop magnetic cores are specifically designed to exhibit an extremely square dc Hysteresis loop and high BSAT resulting in the following important benefits:

- Low saturated permeability
- Low coercive field – indicating a small reset current
- Low profile – enabling weight and volume reduction of up to 50%
- Low loss – resulting from micro-thin METGLAS® ribbon (18µm)

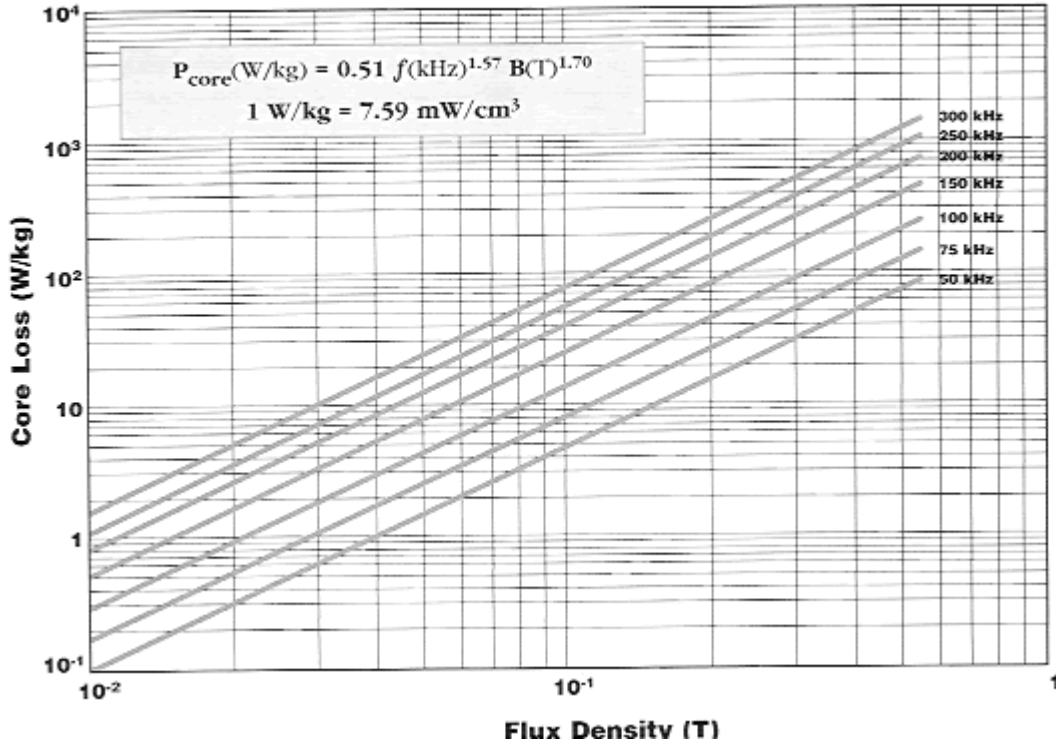
#### Physical Properties METGLAS® Alloy 2714A

|   |         |
|---|---------|
| Ribbon Thickness (µm) . . . . .                 | 18      |
| Density (g/cm <sup>3</sup> ) . . . . .          | 7.59    |
| Thermal Expansion (ppm/°C) . . . . .            | 12.7    |
| Crystallization Temperature (°C) . . . . .      | 560     |
| Curie Temperature (°C) . . . . .                | 225     |
| Continuous Service Temperature (°C) . . . . .   | <120    |
| Tensile Strength (MN/m <sup>2</sup> ) . . . . . | 1k-1.7k |
| Elastic Modulus (GN/m <sup>2</sup> ) . . . . .  | 100-110 |
| Vicker's Hardness (50g load) . . . . .          | 960     |

#### Magnetic Properties METGLAS® Square Loop Cores

|   |      |
|---|------|
| Saturation Flux Density (Tesla) . . . . .   | 0.57 |
| Saturation Magnetostriction (ppm) . . . . . | <<1  |
| Electrical Resistivity (µ-Ω-cm) . . . . .   | 142  |
| Squareness Ratio (%) . . . . .              | >95  |

**Core Loss vs. Flux Density†  
@ 25°C**



**B<sub>80</sub>, B<sub>r</sub>/B<sub>80</sub> vs. Temperature§**



† B<sub>80</sub> - Flux Density @ 80 A/m

**Coercive Force vs. Frequency  
@ 25°C**



**Coercive Force vs. Temperature††**



†† 1 Oe = 79.6 A/m

| MAGAMP<br>COATED CORES | COATED CORE DIMENSIONS WITH<br>OVALITY |         |         | CALCULATED SPECIFICATIONS |                      |                                    |                                    | BARE CORE                            | MAGNETIC<br>SPECIFICATIONS | TEST SPECIFICATIONS |  |
|------------------------|--|---------|---------|---------------------------|----------------------|------------------------------------|------------------------------------|--------------------------------------|----------------------------|---------------------|--|
|                        | Core Type                              | OD (mm) | ID (mm) | Ht (mm)                   | Lm <sup>2</sup> (cm) | Ac <sup>β</sup> (cm <sup>2</sup> ) | Wa <sup>γ</sup> (cm <sup>2</sup> ) | WaAc <sup>x</sup> (cm <sup>4</sup> ) | Mass (g)                   | Bsat (T)            | Squareness Ratio @<br>5kHz / 0.5Oe, 4 Turns<br>(Br/Bm) |
|                        |  | (max)   | (min)   | (max)                     | (nom)                | (nom)                              | (nom)                              | (nom)                                | (nom)                      | (nom)               | (min)  |
| MP1005M4AS             | 11.37                                  | 5.91    | 6.12    | 2.59                      | 0.06                 | 0.27                               | 0.02                               | 1.20                                 | 0.57                       | 84%                 |  |
| MP1105M4AS             | 12.50                                  | 8.76    | 6.29    | 3.24                      | 0.03                 | 0.60                               | 0.02                               | 0.77                                 | 0.57                       | 84%                 |  |
| MP1205M4AS             | 13.30                                  | 7.77    | 6.29    | 3.14                      | 0.06                 | 0.47                               | 0.03                               | 1.39                                 | 0.57                       | 84%                 |  |
| MP1303M4AS             | 14.32                                  | 8.76    | 4.70    | 3.50                      | 0.04                 | 0.60                               | 0.02                               | 1.12                                 | 0.57                       | 84%                 |  |
| MP1305M4AS             | 14.07                                  | 8.76    | 6.29    | 3.46                      | 0.06                 | 0.60                               | 0.03                               | 1.53                                 | 0.57                       | 84%                 |  |
| MP1405M4AS             | 15.54                                  | 8.76    | 6.29    | 3.67                      | 0.08                 | 0.60                               | 0.05                               | 2.35                                 | 0.57                       | 84%                 |  |
| MP1505M4AS             | 16.87                                  | 8.76    | 6.29    | 3.87                      | 0.11                 | 0.60                               | 0.06                               | 3.17                                 | 0.57                       | 84%                 |  |
| MP1506M4AS             | 16.80                                  | 8.76    | 7.87    | 3.86                      | 0.14                 | 0.60                               | 0.08                               | 4.18                                 | 0.57                       | 84%                 |  |
| MP1603M4AS             | 17.58                                  | 11.86   | 4.70    | 4.50                      | 0.04                 | 1.10                               | 0.05                               | 1.43                                 | 0.57                       | 84%                 |  |
| MP1705M4AS             | 18.75                                  | 11.86   | 6.29    | 4.66                      | 0.08                 | 1.10                               | 0.09                               | 2.95                                 | 0.57                       | 84%                 |  |
| MP1706M4AS             | 18.73                                  | 11.86   | 7.87    | 4.68                      | 0.11                 | 1.10                               | 0.12                               | 4.07                                 | 0.57                       | 84%                 |  |
| MP1805M4AS             | 20.25                                  | 11.86   | 6.29    | 4.88                      | 0.11                 | 1.10                               | 0.12                               | 4.10                                 | 0.57                       | 84%                 |  |
| MP1903M4AS             | 21.24                                  | 11.86   | 4.70    | 5.00                      | 0.08                 | 1.10                               | 0.09                               | 3.17                                 | 0.57                       | 84%                 |  |
| MP1905M4AS             | 20.29                                  | 11.86   | 6.29    | 4.92                      | 0.11                 | 1.10                               | 0.12                               | 4.29                                 | 0.57                       | 84%                 |  |
| MP1906M4AS             | 20.97                                  | 11.86   | 7.87    | 4.99                      | 0.16                 | 1.10                               | 0.18                               | 6.23                                 | 0.57                       | 84%                 |  |
| MP2006M4AS             | 21.81                                  | 14.33   | 7.87    | 5.54                      | 0.12                 | 1.61                               | 0.20                               | 5.20                                 | 0.57                       | 84%                 |  |
| MP2008M4AS             | 21.86                                  | 11.86   | 9.91    | 5.15                      | 0.25                 | 1.10                               | 0.27                               | 9.88                                 | 0.57                       | 84%                 |  |
| MP2208M4AS             | 23.69                                  | 15.57   | 9.91    | 6.01                      | 0.18                 | 1.90                               | 0.33                               | 8.16                                 | 0.57                       | 84%                 |  |
| MP2303M4AS             | 24.91                                  | 15.57   | 4.70    | 6.19                      | 0.08                 | 1.90                               | 0.15                               | 3.88                                 | 0.57                       | 84%                 |  |
| MP2306M4AS             | 25.13                                  | 15.57   | 7.87    | 6.23                      | 0.17                 | 1.90                               | 0.32                               | 8.16                                 | 0.57                       | 84%                 |  |
| MP2410M4AS             | 26.30                                  | 18.05   | 11.05   | 6.83                      | 0.21                 | 2.56                               | 0.53                               | 10.91                                | 0.57                       | 84%                 |  |
| MP2505M4AS             | 27.43                                  | 18.05   | 6.29    | 7.01                      | 0.12                 | 2.56                               | 0.32                               | 6.75                                 | 0.57                       | 84%                 |  |
| MP2510M4AS             | 27.47                                  | 18.05   | 11.05   | 7.01                      | 0.25                 | 2.56                               | 0.64                               | 13.50                                | 0.57                       | 84%                 |  |
| MP2705M4AS             | 29.10                                  | 15.57   | 6.29    | 6.89                      | 0.21                 | 1.90                               | 0.39                               | 11.03                                | 0.57                       | 84%                 |  |
| MP3005M4AS             | 32.01                                  | 18.05   | 6.29    | 7.69                      | 0.21                 | 2.56                               | 0.53                               | 12.30                                | 0.57                       | 84%                 |  |
| MP3210M4AS             | 34.72                                  | 21.14   | 11.05   | 8.58                      | 0.39                 | 3.51                               | 1.36                               | 25.78                                | 0.57                       | 84%                 |  |
| MP3506M4AS             | 37.43                                  | 24.24   | 7.87    | 9.52                      | 0.25                 | 4.61                               | 1.15                               | 18.35                                | 0.57                       | 84%                 |  |

\*  $\alpha$  = Mean magnetic path length,  $\beta$  = Net Cross-sectional area,  $\gamma$  = Core Window area and  $x$  = Area product.

\* All measurements are done at Room Temperature (22°C to 28°C)

\* Continuous Operating Temperature : 90°C (max.).

\* Ovality of 5% on outer and inner diameter is permissible.

\* Powder coated core, minimum coating thickness of 0.076 mm (3 mils) is maintained on core surface.

\* Powder Coating Material:-DuPont (EFB534S0) / Manufacturer UL File # E206123.

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| MAGAMP BOXED<br>CORES | BOXED CORE DIMENSIONS |         |         | CALCULATED SPECIFICATIONS |                    |                                 |                                  | BARE CORE                          | MAGNETIC<br>SPECIFICATIONS | TEST SPECIFICATIONS |  |          |
|-----------------------|-----------------------|---------|---------|---------------------------|--------------------|---------------------------------|----------------------------------|------------------------------------|----------------------------|---------------------|--|----------|
|                       | Core Type<br>(X)      | OD (mm) | ID (mm) | Ht (mm)                   | $Lm^{\alpha}$ (cm) | $Ac^{\beta}$ (cm <sup>2</sup> ) | $Wa^{\gamma}$ (cm <sup>2</sup> ) | $WaAc^{\delta}$ (cm <sup>4</sup> ) | Mass (g)                   | Bsat (T)            | Squareness Ratio @<br>5kHz / 0.5Oe, 4 Turns<br>(Br/Bm) |          |
|                       |                       | (max)   | (min)   | (max)                     | (nom)              | (nom)                           | (nom)                            | (nom)                              | (nom)                      | (nom)               | (min) AS   | (min) AH |
| MP1005X4AS            | 11.20                 | 5.30    | 6.00    | 2.59                      | 0.06               | 0.25                            | 0.01                             | 1.20                               | 0.57                       | 86%                 | -  |          |
| MP1205X4AS            | 14.10                 | 6.50    | 6.90    | 3.14                      | 0.06               | 0.36                            | 0.02                             | 1.39                               | 0.57                       | 86%                 | -  |          |
| MP1303X4AS            | 15.00                 | 7.60    | 5.40    | 3.50                      | 0.04               | 0.49                            | 0.02                             | 1.12                               | 0.57                       | 86%                 | -  |          |
| MP1305X4AS            | 14.70                 | 7.60    | 7.00    | 3.46                      | 0.06               | 0.49                            | 0.03                             | 1.53                               | 0.57                       | 86%                 | -  |          |
| MP1405X4AS            | 16.10                 | 7.60    | 7.00    | 3.67                      | 0.08               | 0.49                            | 0.04                             | 2.35                               | 0.57                       | 86%                 | -  |          |
| MP1506X4AS / AH       | 17.40                 | 7.50    | 8.60    | 3.86                      | 0.14               | 0.48                            | 0.07                             | 4.18                               | 0.57                       | 86%                 | 92%  |          |
| MP1603X4AS            | 18.10                 | 10.70   | 5.40    | 4.50                      | 0.04               | 0.95                            | 0.04                             | 1.43                               | 0.57                       | 86%                 | -  |          |
| MP1805X4AS            | 21.10                 | 10.50   | 7.10    | 4.88                      | 0.11               | 0.92                            | 0.10                             | 4.10                               | 0.57                       | 86%                 | -  |          |
| MP1903X4AS            | 21.50                 | 10.70   | 5.40    | 5.00                      | 0.08               | 0.95                            | 0.08                             | 3.17                               | 0.57                       | 86%                 | -  |          |
| MP1906X4AS / AH       | 21.50                 | 10.70   | 8.60    | 4.99                      | 0.16               | 0.95                            | 0.15                             | 6.23                               | 0.57                       | 86%                 | 92%  |          |
| MP2008X4AS / AH       | 22.50                 | 10.70   | 10.70   | 5.15                      | 0.25               | 0.95                            | 0.24                             | 9.88                               | 0.57                       | 86%                 | 92%  |          |
| MP2303X4AS            | 25.20                 | 14.60   | 5.40    | 6.19                      | 0.08               | 1.74                            | 0.14                             | 3.88                               | 0.57                       | 86%                 | -  |          |
| MP2410X4AS / AH       | 28.10                 | 17.00   | 11.80   | 6.83                      | 0.21               | 2.35                            | 0.48                             | 10.91                              | 0.57                       | 86%                 | 92%  |          |
| MP2510X4AS / AH       | 28.10                 | 17.00   | 11.80   | 7.01                      | 0.25               | 2.35                            | 0.58                             | 13.50                              | 0.57                       | 86%                 | 92%  |          |
| MP2705X4AS / AH       | 29.80                 | 14.50   | 7.00    | 6.89                      | 0.21               | 1.72                            | 0.36                             | 11.03                              | 0.57                       | 86%                 | 92%  |          |
| MP3210X4AS / AH       | 35.30                 | 19.60   | 11.80   | 8.58                      | 0.39               | 3.11                            | 1.21                             | 25.78                              | 0.57                       | 86%                 | 92%  |          |

\*  $\alpha$  = Mean magnetic path length,  $\beta$  = Net Cross-sectional area,  $\gamma$  = Core Window area and  $\delta$  = Area product.

\* All measurements are done at Room Temperature (22°C to 28°C)

\* Continuous Operating Temperature :90°C max. (Irrespective of type of box used).

| BOX MATERIAL | BOX<br>DESIGNATION<br>(X) | MATERIAL DuPont | MANUFACTURER<br>UL FILE # | MANUFACTURER<br>FLAMMABILITY<br>RATING |
|--------------|---------------------------|-----------------|---------------------------|--|
|              | P                         | ZYTEL 70G33L    | E41938                    | HB                                     |
|              | L                         | ZYTEL FR50      | E41938                    | 94 V0                                  |
|              | V                         | RYNITE FR530L   | E69578                    | 94 V0                                  |