DATA SHEET

TN36/23/15
Ferrite toroids

Supersedes data of November 2000

2003 July 24

FERROXCUBE
A YAGEO COMPANY

RING CORES (TOROIDS)

Effective core parameters

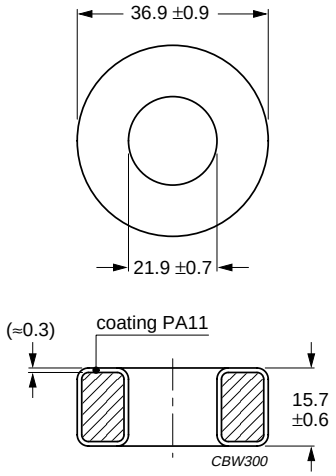
SYMBOL	PARAMETER	VALUE	UNIT
$\Sigma(l/A)$	core factor (C1)	0.935	mm^{-1}
V_e	effective volume	8600	mm^3
l_e	effective length	89.6	mm
A_e	effective area	95.9	mm^2
m	mass of core	≈ 42	g

Coating

The cores are coated with polyamide 11 (PA11), flame retardant in accordance with *"UL 94V-2"*; UL file number E 45228 (M).

Isolation voltage

DC isolation voltage: 2000 V.
Contacts are applied on the edge of the ring core, which is also the critical point for the winding operation.



Dimensions in mm.

Fig.1 TN36/23/15 ring core.

Ring core data

GRADE	A_L (nH)	μ_i	COLOUR CODE	TYPE NUMBER
4C65	170 ± 25%	≈ 125	violet	TN36/23/15-4C65
4A11	940 ± 25%	≈ 700	pink	TN36/23/15-4A11
3R1(1)	–	≈ 800	black	TN36/23/15-3R1
3S4 des	2285 ± 25%	≈ 1700	no color	TN36/23/15-3S4
3F3	2420 ± 25%	≈ 1800	blue	TN36/23/15-3F3
3C90	3090 ± 25%	≈ 2300	ultramarine	TN36/23/15-3C90
3C11	5800 ± 25%	≈ 4300	white	TN36/23/15-3C11
3E25	7390 ± 25%	≈ 5500	orange	TN36/23/15-3E25

Notes

1. Due to the rectangular BH-loop of 3R1, inductance values strongly depend on the magnetic state of the ring core and measuring conditions. Therefore no A_L value is specified. For the application in magnetic amplifiers A_L is not a critical parameter.

WARNING
Do not use 3R1 cores close to their mechanical resonant frequency. For more information refer to *"3R1"* material specification in this data handbook.

Properties of cores under power conditions

GRADE	B (mT) at	CORE LOSS (W) at		
	H = 250 A/m; f = 25 kHz; T = 100 °C	**f = 25 kHz; $\hat{B}$ = 200 mT; T = 100 °C**	**f = 100 kHz; $\hat{B}$ = 100 mT; T = 100 °C**	**f = 400 kHz; $\hat{B}$ = 50 mT; T = 100 °C**
3C90	≥320	≤0.96	≤0.96	
3F3	≥320		≤0.95	≤1.7

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DATA SHEET

TX36/23/15
Ferrite toroids

Supersedes data of November 2000

2002 Feb 01

FERROXCUBE
A YAGEO COMPANY

RING CORES (TOROIDS)

Effective core parameters

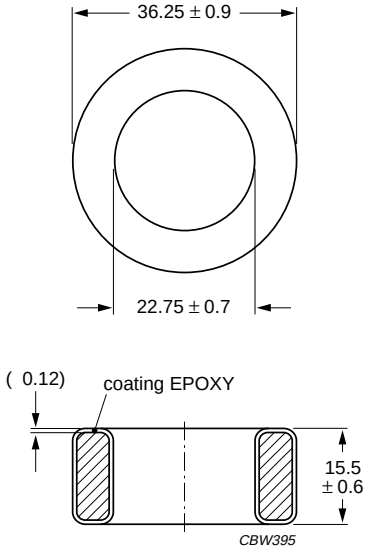
SYMBOL	PARAMETER	VALUE	UNIT
$\Sigma(l/A)$	core factor (C1)	0.96	mm^{-1}
V_e	effective volume	8440	mm^3
l_e	effective length	89.7	mm
A_e	effective area	94.1	mm^2
m	mass of core	≈ 40	g

Coating

The cores are coated with epoxy, flame retardant in accordance with *"UL 94V-0"*; UL file number E 214934.

Isolation voltage

DC isolation voltage: 2000 V.
Contacts are applied on the edge of the ring core, which is also the critical point for the winding operation.



Dimensions in mm.

Fig.1 TX36/23/15 ring core.

Ring core data

GRADE	A_L (nH)	μ_i	COLOUR CODE	TYPE NUMBER
3C90	3090 ± 20%	≈ 2300	ultramarine/white	TX36/23/15-3C90
3C81	3670 ± 20%	≈ 2700	brown/white	TX36/23/15-3C81
3E27 des	6800 ± 20%	≈ 5000	green/white	TX36/23/15-3E27
3E5	11400 ± 20%	≈ 8500	yellow/white	TX36/23/15-3E5
3E6	13600 ± 30%	≈ 10400	purple/white	TX36/23/15-3E6

Properties of cores under power conditions

GRADE	B (mT) at	CORE LOSS (W) at	
	H = 250 A/m; f = 25 kHz; T = 100 °C	$\hat{B}$ = 200 mT; f = 25 kHz; T = 100 °C	$\hat{B}$ = 100 mT; f = 100 kHz; T = 100 °C
3C81	≥320	≤ 1.7	–
3C90	≥320	≤ 0.96	≤ 0.96

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DATA SHEET

3R1
Material specification

Supersedes data of November 2000 2002 Feb 01

FERROXCUBE
A YAGEO COMPANY

3R1 SPECIFICATIONS

MnZn ferrite with a nearly rectangular hysteresis loop for use in magnetic regulators/amplifiers.

SYMBOL	CONDITIONS	VALUE	UNIT
μ_i	25 °C; ≤10 kHz; 0.1 mT	800 ±20%	
B	25 °C; 10 kHz; 250 A/ m	≥ 360	mT
	100 °C; 10 kHz; 250 A/ m	≥ 285	
B_r	from 1 kA/m; 25 °C	≥ 310	mT
	from 1 kA/m; 100 °C	≥ 220	
H_c	from 1 kA/m; 25 °C	≤ 52	A/m
	from 1 kA/m; 100 °C	≤ 23	
ρ	DC; 25 °C	≈ 10^3	Ωm
T_C		≥ 230	°C
density		≈ 4700	kg/m^3

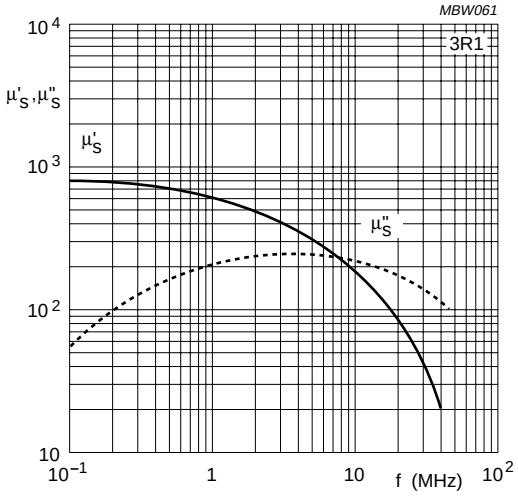

Fig.1 Complex permeability as a function of frequency.

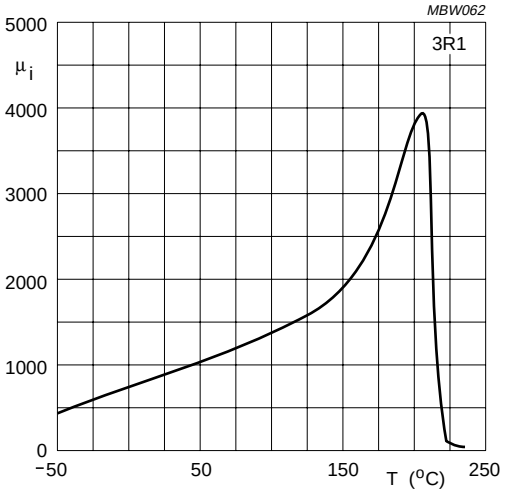

Fig.2 Initial permeability as a function of temperature.

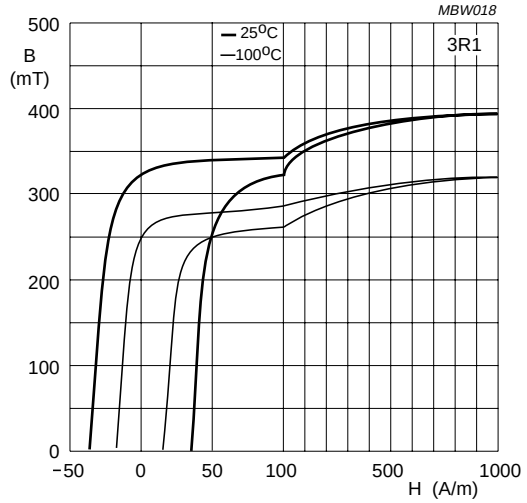

Fig.3 Typical B-H loops.

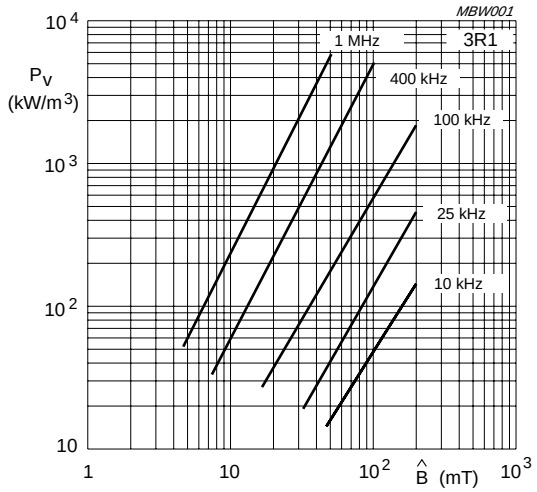

Fig.4 Specific power loss as a function of peak flux density with frequency as a parameter.

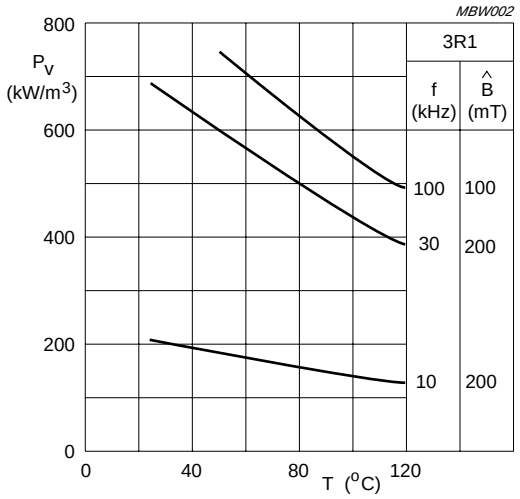

Fig.5 Specific power loss for several frequency/flux density combinations as a function of temperature.

Remark:

When 3R1 ring cores are driven exactly at their natural mechanical resonant frequencies a magneto-elastic resonance will occur. With large flux excursions and no mechanical damping, amplitudes can become so high that the maximum tensile stress of the ferrite is exceeded. Cracks or even breakage of the ring core could be the result. It is advised not to drive the toroidal cores at their radial resonant frequencies or even subharmonics (e.g. half this resonant frequency).

Resonant frequencies can be calculated for any ring core with the following simple formula:

$$f_r = \frac{5700}{\pi\left(\frac{D_o + D_i}{2}\right)} \text{ kHz}$$

where:

f = radial resonant frequency (kHz)

D_o = outside diameter (mm)

D_i = inside diameter (mm).

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DATA SHEET

3E25
Material specification

Supersedes data of November 2000 2002 Feb 01

FERROXCUBE
A YAGEO COMPANY

3E25 SPECIFICATIONS

A medium permeability material mainly for use in current compensated chokes in EMI-suppression filters.

SYMBOL	CONDITIONS	VALUE	UNIT
μ_i	25 °C; ≤10 kHz; 0.1 mT	6000 ± 20%	
B	25 °C; 10 kHz; 250 A/m	≈ 350	mT
	100 °C; 10 kHz; 250 A/m	≈ 180	
$\tan\delta/\mu_i$	25 °C; 100 kHz; 0.1 mT	$\leq 25 \times 10^{-6}$	
	25 °C; 300 kHz; 0.1 mT	$\leq 200 \times 10^{-6}$	
ρ	DC; 25 °C	≈ 0.5	Ωm
T_C		≥ 125	°C
density		≈ 4900	kg/m^3

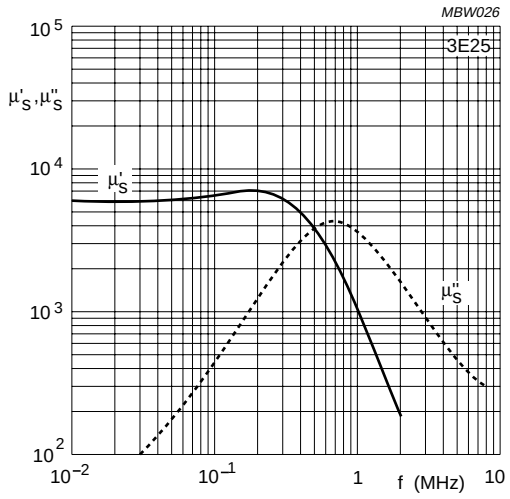

Fig.1 Complex permeability as a function of frequency.

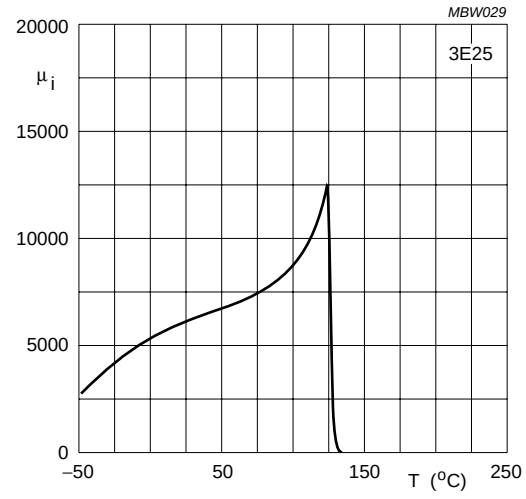

Fig.2 Initial permeability as a function of temperature.

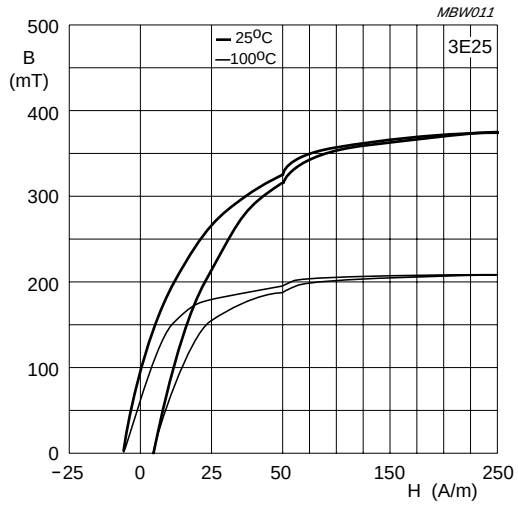

Fig.3 Typical B-H loops.

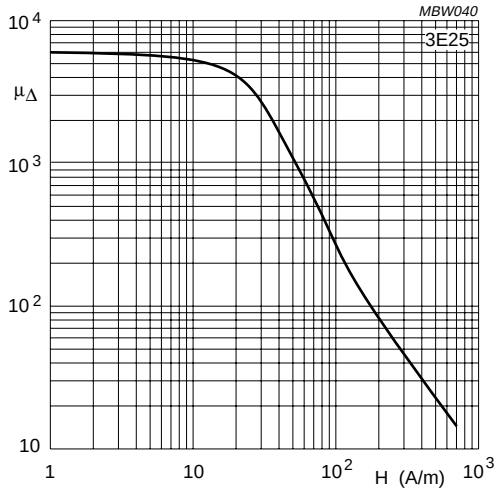

Fig.4 Incremental permeability as a function of magnetic field strength.

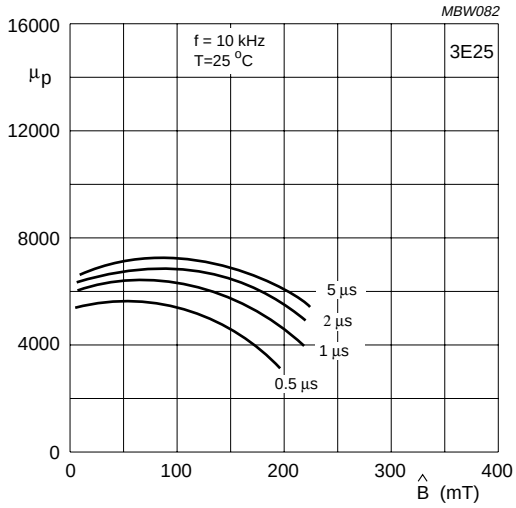

Fig.5 Pulse characteristics (unipolar pulses).

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DATA SHEET

3F3
Material specification

Supersedes data of November 2000 2002 Feb 01

FERROXCUBE
A YAGEO COMPANY

3F3 SPECIFICATIONS

A medium frequency power material for use in power and general purpose transformers at frequencies of 0.2 - 0.5 MHz.

SYMBOL	CONDITIONS	VALUE	UNIT
μ_i	25 °C; ≤10 kHz; 0.1 mT	2000 ±20%	
μ_a	100 °C; 25 kHz; 200 mT	≈ 4000	
B	25 °C; 10 kHz; 250 A/m	≥400	mT
	100 °C; 10 kHz; 250 A/m	≥330	
P_V	100 °C; 100 kHz; 100 mT	≤80	kW/m^3
	100 °C; 400 kHz; 50 mT	≤150	
ρ	DC; 25 °C	≈ 2	Ωm
T_C		≥200	°C
density		≈ 4750	kg/m^3

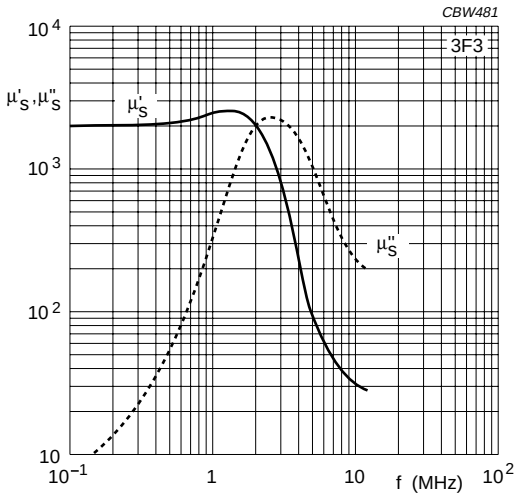

Fig.1 Complex permeability as a function of frequency.

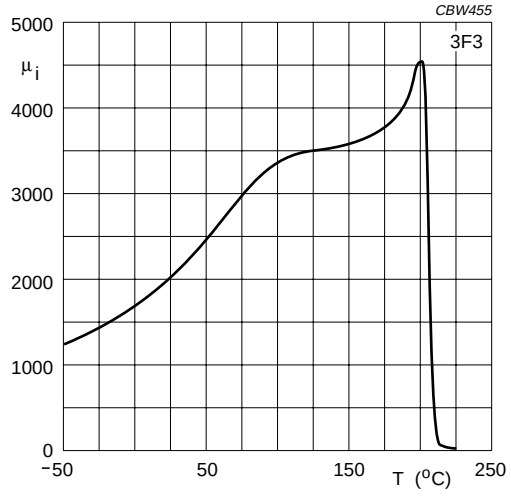

Fig.2 Initial permeability as a function of temperature.

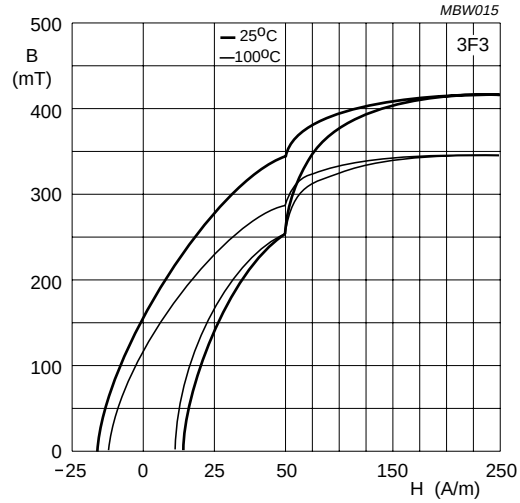

Fig.3 Typical B-H loops.

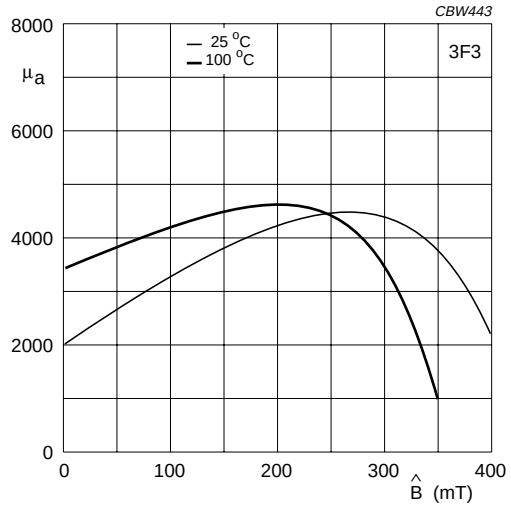

Fig.4 Amplitude permeability as function of peak flux density.

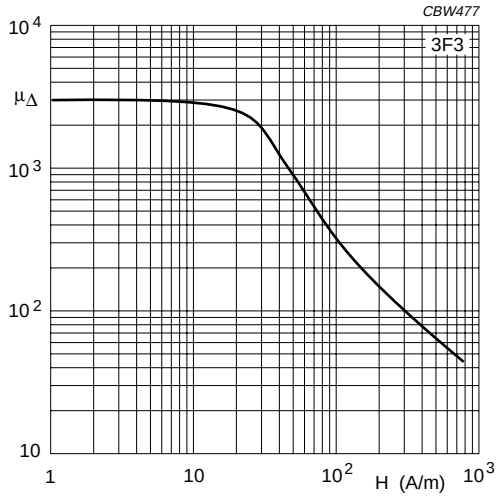

Fig.5 Incremental permeability as a function of magnetic field strength.

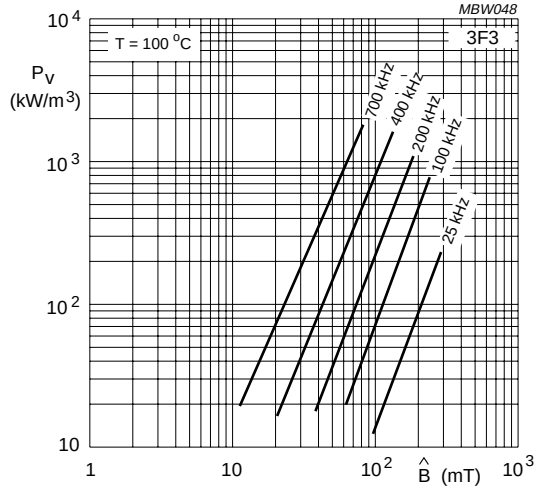

Fig.6 Specific power loss as a function of peak flux density with frequency as a parameter.

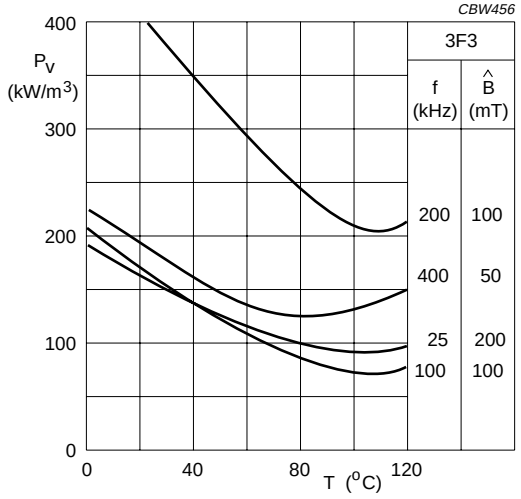

Fig.7 Specific power loss for several frequency/flux density combinations as a function of temperature.

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DATA SHEET

4A11
Material specification

Supersedes data of November 2000 2002 Feb 01

FERROXCUBE
A YAGEO COMPANY

4A11 SPECIFICATIONS

Medium permeability NiZn ferrite for use in wideband EMI-suppression (30 - 1000 MHz) as well as RF wideband and balun transformers.

SYMBOL	CONDITIONS	VALUE	UNIT
μ_i	25 °C; ≤10 kHz; 0.1 mT	850 ±20%	
B	25 °C; 10 kHz; 250 A/m	≈ 270	mT
	100 °C; 10 kHz; 250 A/m	≈ 180	
$\tan\delta/\mu_i$	25 °C; 1 MHz; 0.1 mT	$\leq 100 \times 10^{-6}$	
	25 °C; 3 MHz; 0.1 mT	$\leq 1000 \times 10^{-6}$	
ρ	DC; 25 °C	$\approx 10^5$	Ωm
T_C		≥ 125	°C
density		≈ 5100	kg/m^3

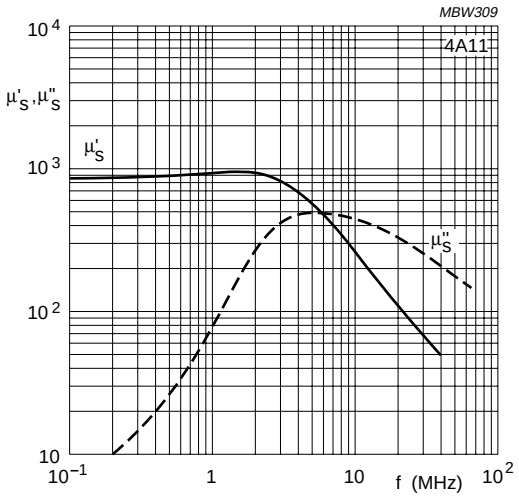

Fig.1 Complex permeability as a function of frequency.

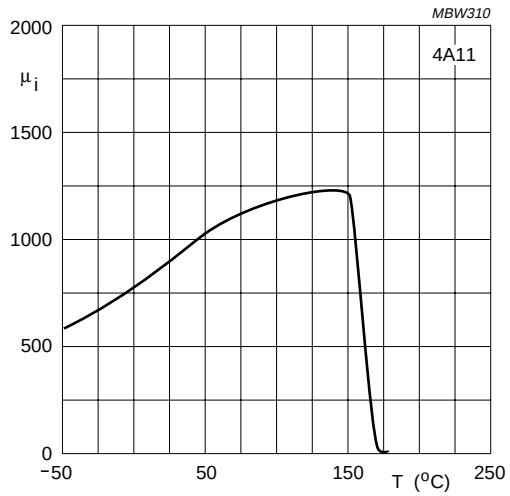

Fig.2 Initial permeability as a function of temperature.

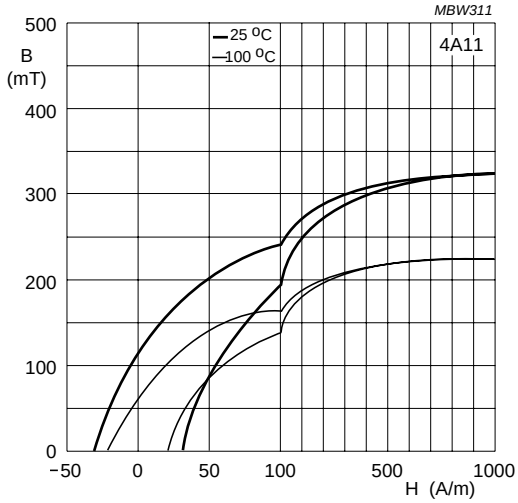

Fig.3 Typical B-H loops.

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DATA SHEET

4C65
Material specification

Supersedes data of November 2000 2002 Feb 01

FERROXCUBE
A YAGEO COMPANY

4C65 SPECIFICATIONS

Low permeability NiZn ferrite for use in RF tuning, wideband and balun transformers.

SYMBOL	CONDITIONS	VALUE	UNIT
μ_i	25 °C; ≤10 kHz; 0.1 mT	125 ±20%	
B	25 °C; 10 kHz; 250 A/m	≈ 300	mT
	100 °C; 10 kHz; 250 A/m	≈ 250	
$\tan\delta/\mu_i$	25 °C; 3 MHz; 0.1 mT	$\leq 80 \times 10^{-6}$	
	25 °C; 10 MHz; 0.1 mT	$\leq 130 \times 10^{-6}$	
ρ	DC; 25 °C	$\approx 10^5$	Ωm
T_C		≥ 350	°C
density		≈ 4500	kg/m^3

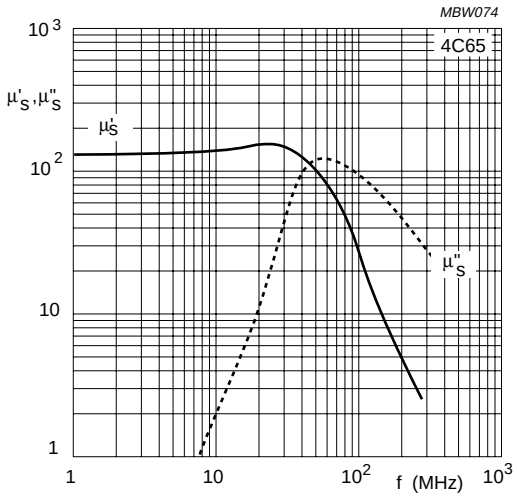

Fig.1 Complex permeability as a function of frequency.

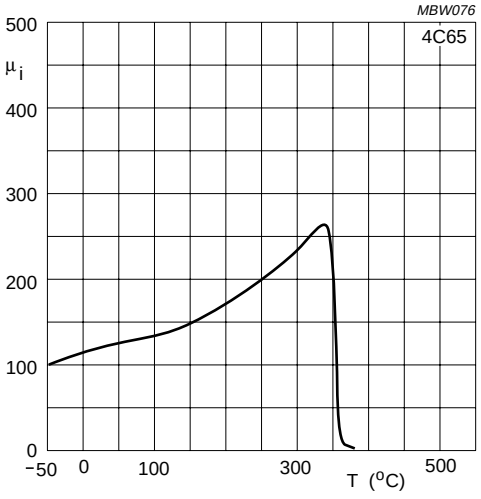

Fig.2 Initial permeability as a function of temperature.

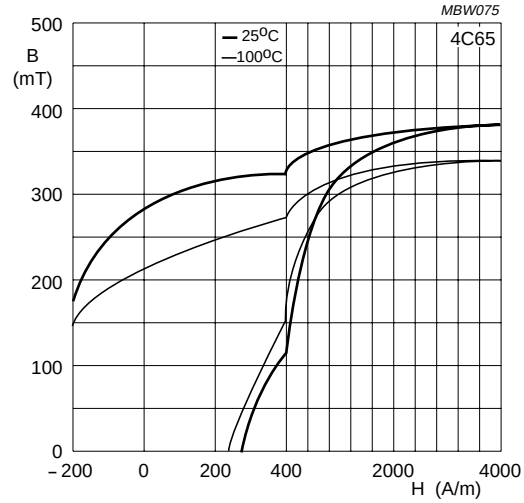

Fig.3 Typical B-H loops.

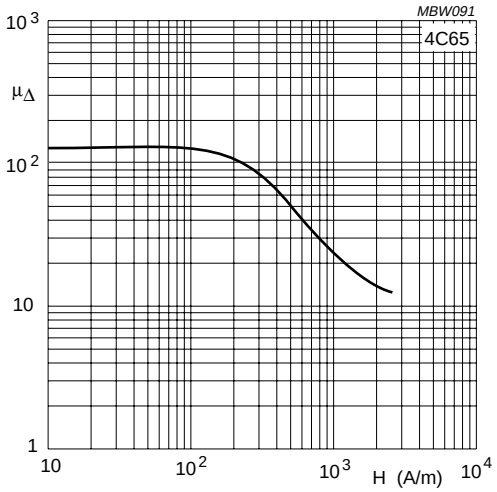

Fig.4 Incremental permeability as a function of magnetic field strength.

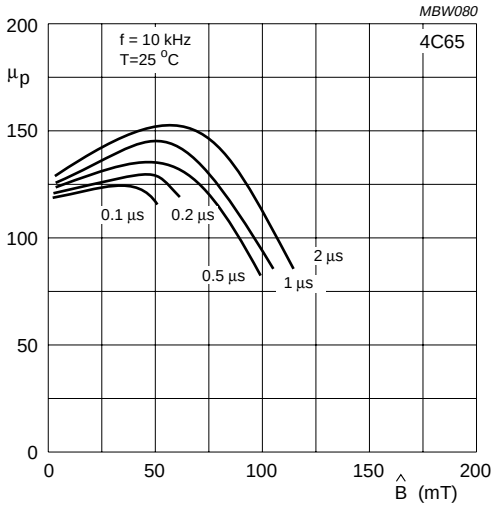

Fig.5 Pulse characteristics (unipolar pulses).

DATA SHEET STATUS DEFINITIONS

DATA SHEET STATUS	PRODUCT STATUS	DEFINITIONS
Preliminary specification	Development	This data sheet contains preliminary data. Ferroxcube reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
Product specification	Production	This data sheet contains final specifications. Ferroxcube reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.

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PRODUCT STATUS DEFINITIONS

STATUS	INDICATION	DEFINITION
Prototype	prot	These are products that have been made as development samples for the purposes of technical evaluation only. The data for these types is provisional and is subject to change.
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Preferred		These products are recommended for use in current designs and are available via our sales channels.
Support	sup	These products are **not** recommended for new designs and may not be available through all of our sales channels. Customers are advised to check for availability.