6.622 Power Electronics — Issued: February 27, 2023
Problem Set 3 — Due: March 6, 2023

Reading: KPVS Chapter 18, Chapter 19 sections 19.1, 19.4.1

Problem 3.1

Partial data for a Philips ER35/21/11 ferrite core half is illustrated in Figure 1. Two of these core halves are placed together to form a closed magnetic path, with a winding encircling the center leg of the core set. The (Philips 3C90) material permeability is $1900\mu_0$, and the allowed flux density B_S is approximately 0.35 T.

a. Create a magnetic circuit model for a winding on this core set, including the reluctances of the main magnetic paths. (You need not consider "leakage flux" traveling through the air.)
b. Please find the *specific inductance*, A_L, of the core set. A_L is the number of nanoHenries for a single-turn winding.
c. How many ampere-turns can be applied in a winding on the core without exceeding the maximum allowed flux density?
d. What is the maximum (saturation) current limit for a 10-turn winding on the core?
e. A 250 µm gap is now inserted in the center leg of the core set (by grinding down the center leg of one of the core halves). Find the inductance and maximum (saturation) current for this new configuration with a 10-turn winding. How does the total energy storage capability compare to the ungapped case?

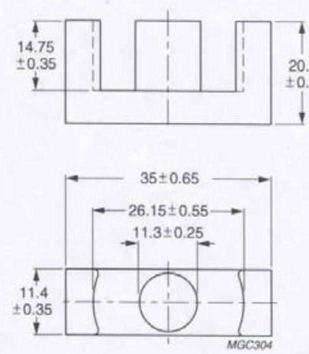
Ferroxcube

ER cores and accessories — ER35/21/11

CORE SETS

Effective core parameters

SYMBOL	PARAMETER	VALUE	UNIT
$\Sigma(I/A)$	core factor (C1)	0.849	mm^{-1}
V_e	effective volume	9710	mm^3
I_e	effective length	90.8	mm
A_e	effective area	107	mm^2
A_{min}	minimum area	100	mm^2
m	mass of core half	≈ 23	g



Dimensions in mm.

Fig.1 ER35/21/11 core half.

Figure 1 Partial data for an ER ferrite core half from Philips components.

Problem 3.2 KPVS Problem 18.8

Note: Further data for various RM cores can be found in KPVS Table 20.1

Problem 3.3 KPVS Problem 18.13

Problem 3.4 KPVS Problem 19.1

Problem 3.5 KPVS Problem 19.2