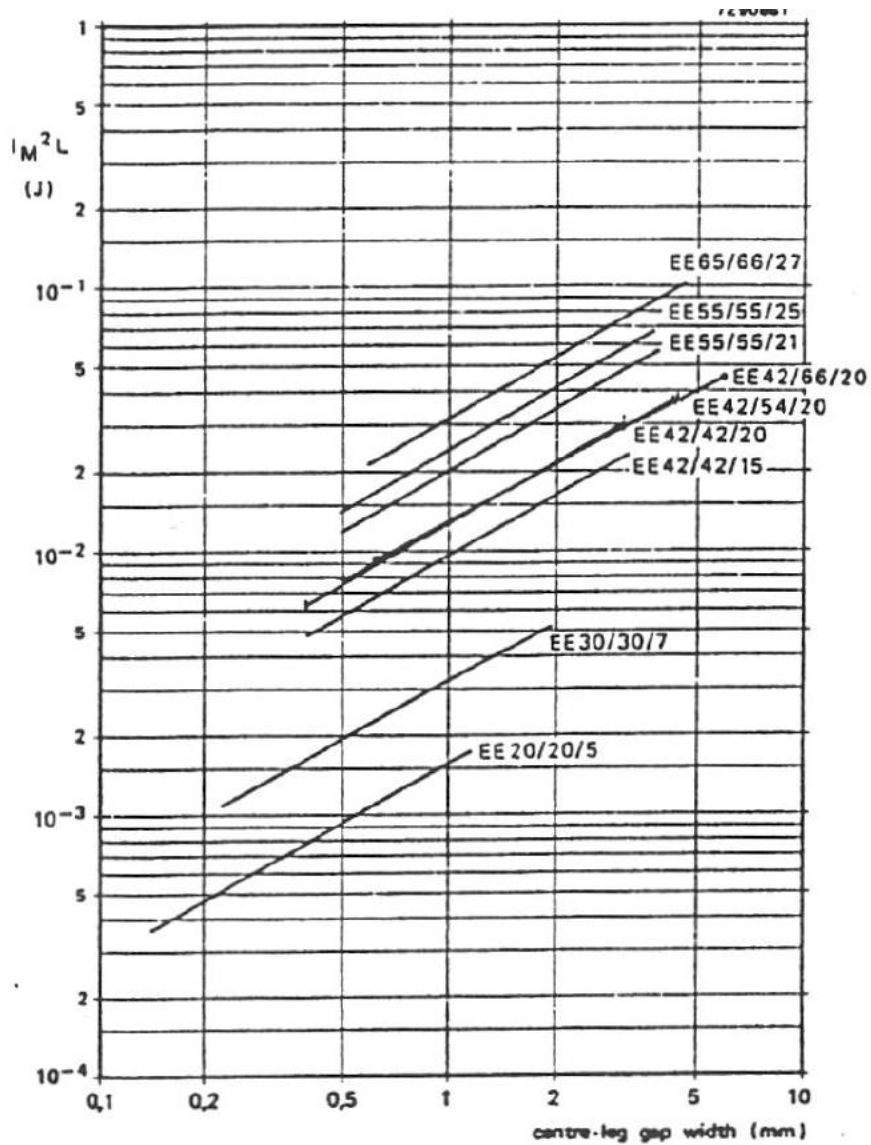


1. Explain shortly (2...4 sentences + possible drawing), what the following terms mean
  - Miller effect
  - Reverse recovery charge
  - SOA
  - Prospective short-circuit current
  - ESR.
2. Describe the construction, functioning principle and properties of IGBT.
3. Discuss filters used for the filtering of EMC, their operating principles and components used.
4. A dc-dc converter has a Mosfet dissipating 40 W and a freewheeling diode dissipating 24 W. Both devices and mounted on a common heatsink. The Mosfet junction-to-case thermal resistance is 0,7 K/W and case-to-heatsink resistance 0,5 K/W. For the diode the same values are 0,8 K/W and 0,6 K/W respectively. Calculate the maximum heatsink thermal resistance so that for both devices junction temperatures are below 90°C when ambient temperature is 30 °C.
5. DC current is filtered with an inductor made from two E55/28/21 half creating E55/55/21. Average current is 44 A and peak-to-peak variation 2,5 A. The needed inductance is at least 15  $\mu$ H. Calculate the turns number and length of air gap by using the attached graph and datasheet. Also, calculate the maximum flux density.



**E 55/28/21**

**Core**

**B66335**

- To IEC 61246
- Delivery mode: single units

**Magnetic characteristics (per set)**

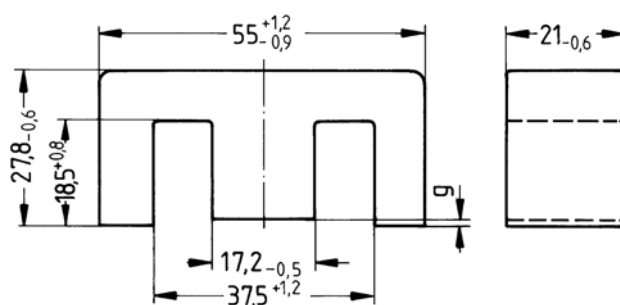
$\Sigma l/A = 0.35 \text{ mm}^{-1}$

$l_e = 124 \text{ mm}$

$A_e = 354 \text{ mm}^2$

$A_{min} = 351 \text{ mm}^2$

$V_e = 43900 \text{ mm}^3$



FEK0142-Y

**Approx. weight 215 g/set**

**Ungapped**

Material	$A_L$ value nH	$\mu_e$	$B_S^*$ mT	$P_V$ W/set	Ordering code
N27	5800 +30/-20%	1610	320	< 8.00 (200 mT, 25 kHz, 100 °C)	B66335G0000X127
N87	6400 +30/-20%	1780	320	< 3.80 (100 mT, 100 kHz, 100 °C)	B66335G0000X187
N97	6700 +30/-20%	1868	320	< 3.34 (100 mT, 100 kHz, 100 °C)	B66335G0000X197

\*  $H = 250 \text{ A/m}$ ;  $f = 10 \text{ kHz}$ ;  $T = 100 \text{ °C}$

**Gapped**

Material	g	$A_L$ value approx. nH	$\mu_e$	Ordering code ** = 27 (N27) = 87 (N87)
	mm			
N27, N87	0.50 ±0.05	843	234	B66335G0500X1**
	1.00 ±0.05	496	138	B66335G1000X1**
	1.50 ±0.05	364	101	B66335G1500X1**
	2.00 ±0.05	292	81	B66335G2000X1**

The  $A_L$  value in the table applies to a core set comprising one ungapped core (dimension  $g = 0$ ) and one gapped core (dimension  $g > 0$ ).

**Calculation factors** (for formulas, see “E cores: general information”)

Material	Relationship between air gap – $A_L$ value		Calculation of saturation current			
	K1 (25 °C)	K2 (25 °C)	K3 (25 °C)	K4 (25 °C)	K3 (100 °C)	K4 (100 °C)
N27	496	-0.764	836	-0.847	781	-0.865
N87	496	-0.764	800	-0.796	765	-0.873

Validity range: K1, K2:  $0.15 \text{ mm} < s < 3.50 \text{ mm}$   
K3, K4:  $180 \text{ nH} < A_L < 1799 \text{ nH}$