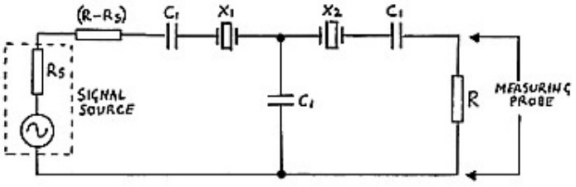
1.) Calculate source and load resistance for two crystals (test circuit):

$C_1 := 0.0000000001$ F = 100pF $f := 9000000$ Hz = 9MHz

$$R := \frac{0.613}{2 \cdot \pi \cdot f \cdot C_1} = 108.402$$ Ohm

2.) Set up test circuit and measure the bandwidth:



$BW_1 := 1030$ Hz

... measured bandwidth

3.) Calculate C2 with required bandwidth

$BW_2 := 2700$ Hz = 2.7kHz ... required bandwidth

$$C_2 := C_1 \cdot \left(\frac{BW_1}{BW_2}\right)^2 = 0.0000000000146$$ F = 14.6pF

4.) Calculate final source and load resistance

$$R := \frac{0.613}{2 \cdot \pi \cdot f \cdot C_2} = 744.888$$ Ohm --> Transformer needed!

5.) Calculate transformer:

$Z_P := 1500$ Ohm $Z_S := R = 744.888$ Ohm

$$\ddot{u} := \sqrt{\frac{Z_P}{Z_S}} = 1.419$$

--> Guideline: 4T:22T @ FT37-43 Toroid Core
--> $L_P := 5.6 \cdot 10^{-6}$ H @ FT37-43 Toroid Core
--> $L_S := 169.4 \cdot 10^{-6}$ H @ FT37-43 Toroid Core

$$\ddot{u}_{dB} := 10 \cdot \log(\ddot{u}) = 1.52$$ dB --> 1.52dB loss!

$$Z_S := Z_P \cdot \left(\frac{22}{4}\right)^2 = 45375$$ Ohm

Requirement:

$X_{LP} := 2 \cdot \pi \cdot f \cdot L_P = 316.673$ Ohm > $9 \cdot Z_P = 13500$ Ohm --> correct!

$X_{LS} := 2 \cdot \pi \cdot f \cdot L_S = 9579.344$ Ohm > $9 \cdot Z_{IN} = ?$ Ohm --> correct!

6.) Calculate capacitors for final ladder topology:

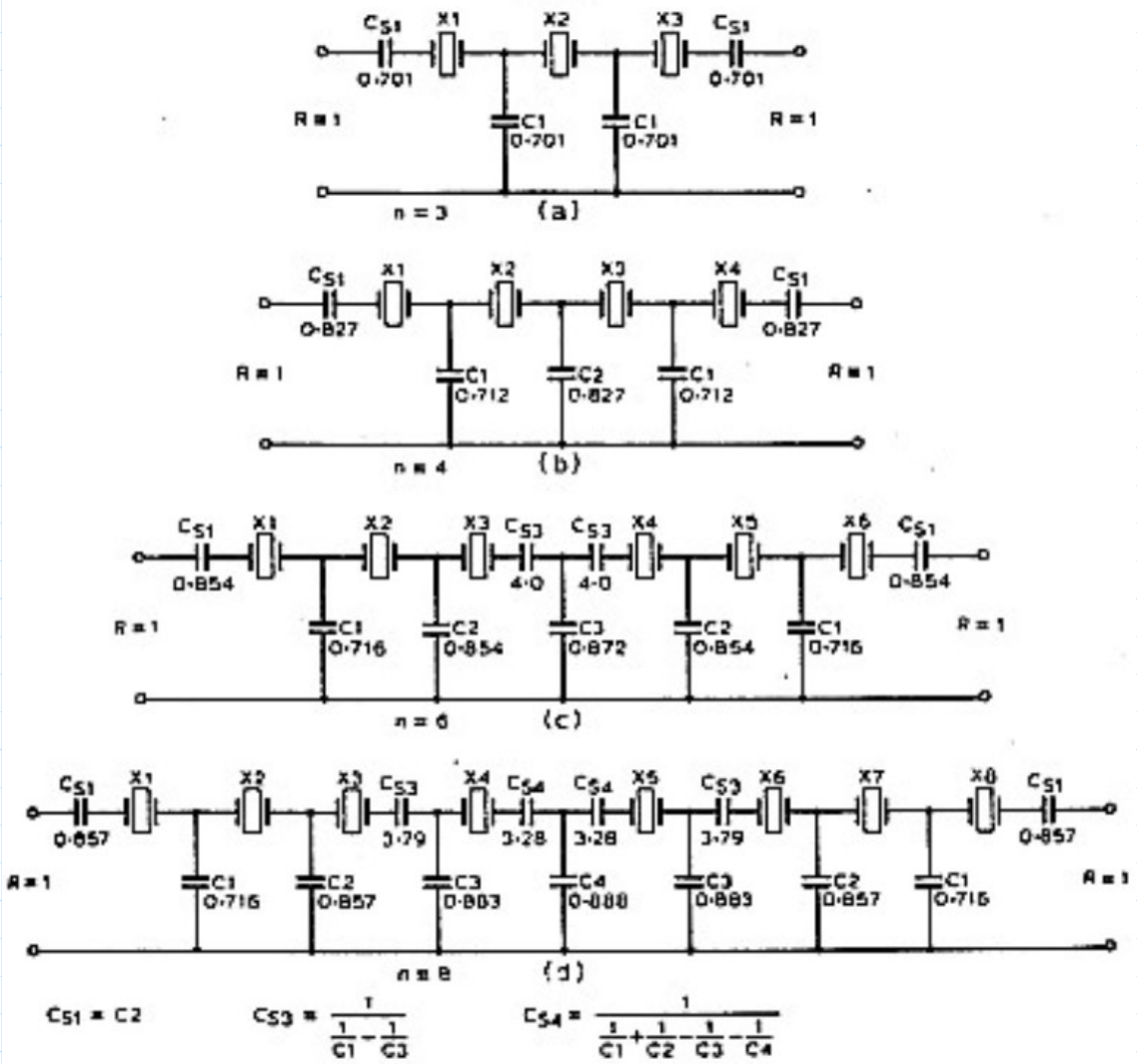
Ladder topology b) is used here:

$$C(K) := \frac{K}{2 \cdot \pi \cdot f \cdot R}$$

$C_{S1} := C(0.827) = 0.0000000000196$ F = 19.6pF = 20pF

$C_1 := C(0.712) = 0.0000000000169$ F = 16.9pF = 2x 33pF in series = 16.5pF

$C_2 := C(0.827) = 0.0000000000196$ F = 19.6pF = 20pF



Formulas: http://www.i1wqrlinkradio.com/antype/ch97/chiave40.htm