

Discrete Single Element Fractional Capacitor; $\alpha = 0.45$, $C_\alpha = 120 \text{ nFs}^{-0.55}$

Key Features

- Typ. fractional order: $\alpha = 0.45$
- Typ. fractance: $C_\alpha = 120 \text{ nFs}^{-0.57}$
- Typ. operational bandwidth: 8 kHz – 4 MHz
- Max. absolute error in phase: 3.5 deg
- Thick-film technology design

Typical applications

- Frequency filters
- Signal oscillators
- Synthetic immittance elements
- Fractional-order circuits and systems
- Behavioural modelling

General description

The capFOE_045 is an experimental prototype of passive capacitive type fractional-order element; featuring typical values of fractional order $\alpha = 0.45$ and fractance $C_\alpha = 120 \text{ nFs}^{-0.55}$. The element is based on resistive-capacitive layered structures with distributed parameters (RC-EDP). The production of the element was performed in a thick-film technology. The dimension of capFOE_045 is 42 mm × 13 mm (excluding pins).

Specifications

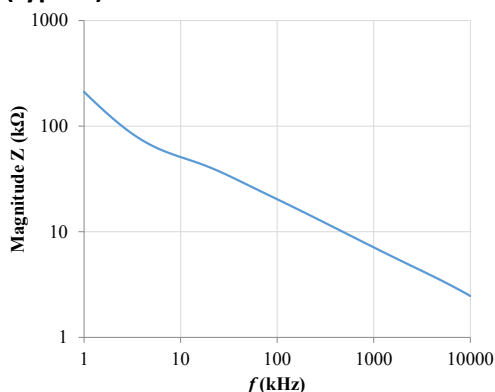
Table 1. Electrical characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Fractional order	α	0.44	0.45	0.49	-
Fractance	C_α	68	120	142	$\text{nFs}^{-0.55}$
Min. frequency of operation	f_{\min}		8		kHz
Max. frequency of operation	f_{\max}		4		MHz
Impedance magnitude ¹			15.2		k Ω
Impedance phase ¹			-40.6		deg
Max. absolute error in impedance magnitude ¹				3.2	k Ω
Max. absolute error in impedance phase ¹				3.5	deg
Max. relative error in impedance magnitude ¹				21	%
Max. relative error in impedance phase ¹				8.6	%

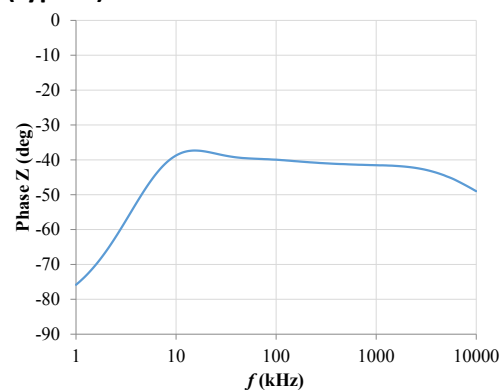
¹at central frequency 180 kHz

Electrical characteristics

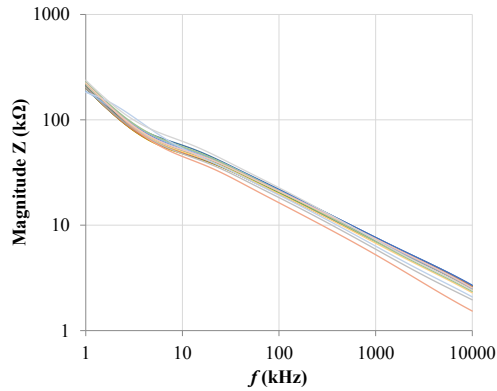
Impedance magnitude of the capFOE_045 (typical)



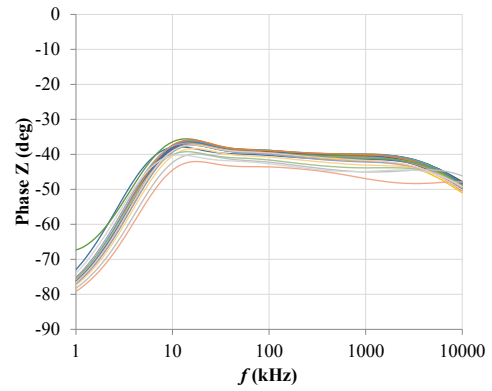
Impedance phase of the capFOE_045 (typical)



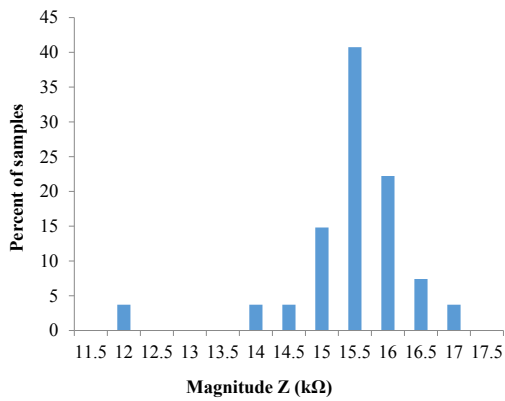
Impedance magnitude of the capFOE_045 (26 samples)



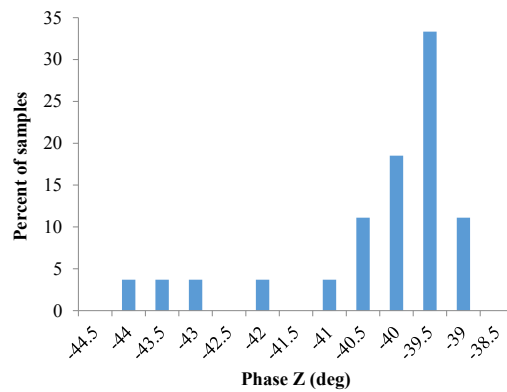
Impedance phase of the capFOE_045 (26 samples)



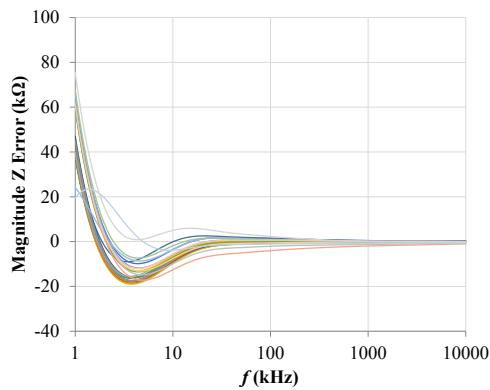
Histogram of impedance magnitude of the capFOE_045 at central frequency 180 kHz (26 samples)



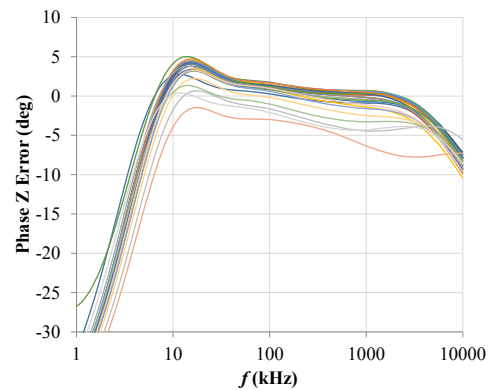
Histogram of impedance phase of the capFOE_045 at central frequency 180 kHz (26 samples)



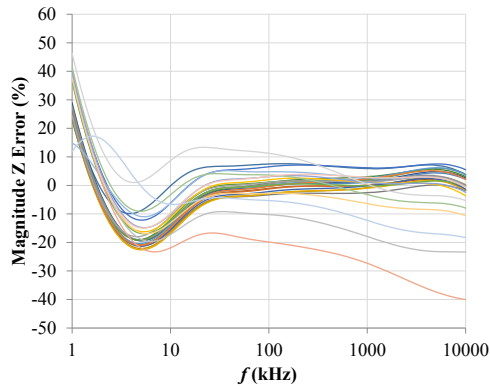
Absolute error in magnitude of the capFOE_045 (26 samples)



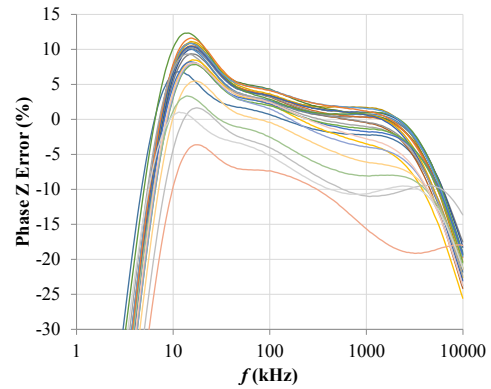
Absolute error in phase of the capFOE_045 (26 samples)



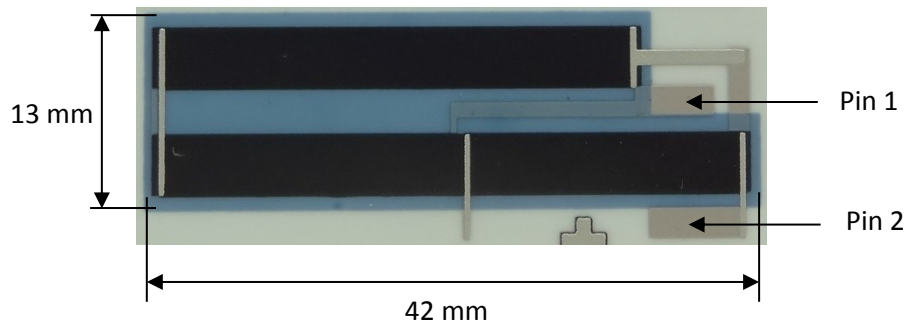
Relative error in magnitude of the capFOE_045 (26 samples)



Relative error in phase of the capFOE_045 (26 samples)



Top view of capFOE_045 and dimensions



The design of the capFOE_045 prototype was done within the INTER-EXCELLENCE COST project No. LTC18022, Czech Republic, and as a contribution to COST Action CA15225.



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COST Action CA15225; fractional-systems.eu