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Active Power Evolution by Reactive Elements under the Expofunctional Input Signal Phenomenon Research

A. M. Ivanitckiy and D. G. Pascu
Odessa National Academy of Telecommunications, Odessa, Ukraine
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Abstract—Measuring device prototype for measure of amplitude-frequency characteristics of systems, containing linear *RLC*-circuits considering expo-harmonic periodic input signals developed and fabricated. We prove a possibility of application of phenomenon of active power evolution by reactive elements in case of exponential input signals.

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Usage of new physical effects in radio technical elements and units allows to make easily a solution of problem of a radio communication improvement. One of such physical effects is active power evolution in electric circuit reactive elements. This phenomenon was described and proved experimentally in paper [1]. This phenomenon is observed in case of exponential input signals [2]. Latest theoretical researches of electrical circuits operating with exponential input signals [3–6] proved possibility of the active power of electric circuit reactive elements application in telecommunication field. However, there is a problem of experimental research of this phenomenon because of absence of appropriate measuring device. Therefore, the purpose of this work is to develop and create such measuring devise prototype, which can measure amplitude-frequency response (AFR) of a system, containing linear quadripole with reactive elements under the influence expo-harmonic input signal. We can prove researched phenomenon using this device.

We explain presence of the active power evolution in reactive elements with an example of impact on a reactive (inductance or capacity) element of a signal with expo-harmonical shape [1, 2]

$$f(t) = \mathrm{e}^{-\lambda t}\tilde{f}(t) = F_m \mathrm{e}^{-\lambda t}\sin\omega t,$$

where F_m is harmonic signal amplitude; λ is positive real number; ω is cyclic frequency; t is time. Here $\tilde{f}(t) = F_m \sin\omega t$ is exponential function kernel.

Let inductance current is $i_L(t) = I_{Lm}\mathrm{e}^{-\lambda t}\sin\omega t$, then inductance instantaneous power is

$$p_L(t) = u_L(t)i_L(t) = L\frac{\mathrm{d}\,i_L(t)}{\mathrm{d}\,t}i_L(t) = -\lambda L I_{Lm}^2 \mathrm{e}^{-2\lambda t}\sin^2\omega t + \omega L I_{Lm}^2 \mathrm{e}^{-2\lambda t}\sin\omega t\cos\omega t. \tag{1}$$

Using generalized symbolical method, we can write following expression [7]:

$$\dot{U}_L = pL\dot{I}_L = (-\lambda + \mathrm{j}\omega)L\dot{I}_L,$$

$$\dot{S} = \dot{U}_L \overset{*}{I}_L = -\lambda L I_L^2 + \mathrm{j}\omega L I_L^2 = P + \mathrm{j}Q, \tag{2}$$

where $\dot{S}$ is complex power, P is active power, Q is reactive power.

Comparing formulas (1) and (2) we conclude that the first item in expression (1) derives active power, scattering by inductance in external circuit, and the second item derives reactive power. The active power