An idea of the 5th stage power domain ELIN RMS-to-DC converter

Adam Pilsniak*

*Institute of Measurement Science, Electronics and Control, Silesian University of Technology, Akademicka 10, Gliwice, Poland, e-mail: adam.pilsniak@polsl.pl

Abstract **Analog RMS-DC converters are increasingly used in popular multimeters. Their advantage is low uncertainty over a wide frequency range. However, when measuring small voltages the uncertainty is high.**

Keywords **RMS-to-DC converter, ELIN circuit**

I. ELIN RMS-TO-DC CONVERTERS

Errors in measurements of small voltages are caused by nonlinear processing of an RMS-DC converter, particularly for the device (Figure 1), which operates according to the formula:

$$U_{\mathbf{RMS}} = \sqrt{\frac{1}{T}\int_0^T u^2(t)\mathbf{d}t} \tag{1}$$

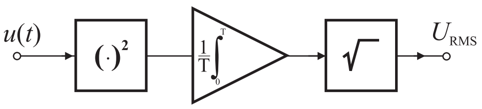

Fig. 1. Scheme of standard RMS-DC converter.

The input square block, in addition to its mathematical function, operates as an expander. High level signals are amplified while the small ones more attenuated. This leads to a lower dynamics (the conversion range). To the upper limit there are used appropriated factor. Therefore solutions containing the dividing feedback are applied in practice [1]. The author has realized some solutions based on externally linear, internally nonlinear (ELIN) filters which use the dividing feedback [2].

II. POWER DOMAIN ELIN RMS-DC CONVERTERS

Using the filter ELIN in the system of Figure 1, there is obtained a general scheme of the ELIN RMS-DC converter (Figure 2).

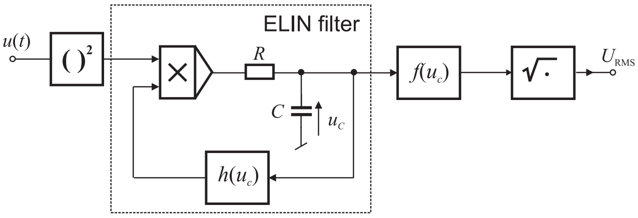

Fig. 2. The scheme of ELIN RMS-DC converter.

Assuming power functions to be $f(u_C)$ and $h(u_C)$ there is obtained an ELIN RMS-DC power domain converter [3]. The advantage of this solution is the ability to realize a device by means of multipliers only. Where assuming that $f(x) = u_C^5$, the linearization function (in the feedback) has the form $h(x) = u_C^{-4}$.

The power functions operations such as multiplication, division, allow optimize the size of the circuit.Function blocks can be moved and connect in according to laws of math. For example the output function:

$$u_C^{\frac{5}{2}} = u_C\sqrt{U_C}, \tag{2}$$

and feedback function:

$$u_C^{-4} = \frac{1}{(u_c^2)^2}. \tag{3}$$

The block diagram of the converter is shown in Figure 3.

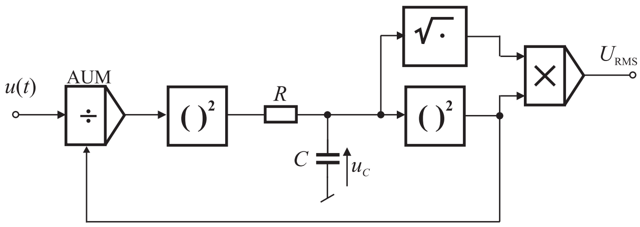

Fig. 3. The scheme of 5th stage power domain ELIN RMS-DC converter.

III. CONCLUSIONS

A new type of RMS-DC converter is presented in the paper. The main advantage of presented device is a wider conversion range due to internal signal compression. This property has been observed for power domain ELIN RMS-DC converters, when a value of the exponent is higher than 2. The discussed converter is realized based on power domain functions. That is the reason why the converter structure is flexible. Thanks to this feature, there is presented the optimal structure of the 5th stage ELIN RMS-DC converter in the paper.

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