УДК 621.3

Increasing CUE pulsed source of secondary electrofeeding

A.P.Puzanov, candidate of technical sciences

Analyse structured secondary power source schemes with the stabilization of source voltage by the width-pulse modulator with the transistor key, which is laden on the pulsed transformer. Such schemes enable reach features 300 Вт/дм3 at the transformation frequency before 200 кГц and coefficient of useful effect (CUE) before 70%.

Considered resonance and kvaziresonance scheme AC/DC- converters with use LC-sidebars. Shown that resonance scheme has more high stability and efficiency, enable at the frequency of transformation 2 MHZ reach a small-dimensioned feature before 930 Wт/dm^3 for sources with the source power before 100 Вт under CUE before 87%.

Converter of voltage, width-pulse modulator, stabilizer of voltage, resonance chain, efficiency.

Quick development of new semiconductor technologies has bring about revolutions and in such area of electrical engineering, as power sources. For a short term of secondary power sources are radically change: on change to bulky devices with the network transformer and additional transistor stabilizer come tiny pulsed modulas. Release small-dimensioned AC/DC converters in bodies of usual microcircuits.

Purpose of studies - increasing of efficiency of pulsed power sources.

Material and strategy of studies. Main power sources are site supply systems with standard parameters. Usually in town networks an electric power is given consumer in the manner of трехфазного current with the single-line voltage 380 V

and frequency 50 (±0,5 Hz) with фазным by the voltage 220 V. Quality of supply is defined by USSR Standart 13109-99, however стабильность voltages and frequencies in primary networks of electropower supply nonhigh, that brings about need of using the stabilizers of alternating current even in primary electropower supply circuits. For power supply the modern electrotechnical devices needed sources of the direct current by the voltage +5 V, +12 V or +27 V. Converters of variable voltage 220 In in constant (AC/DC) name the secondary power sources (SPS) [3].

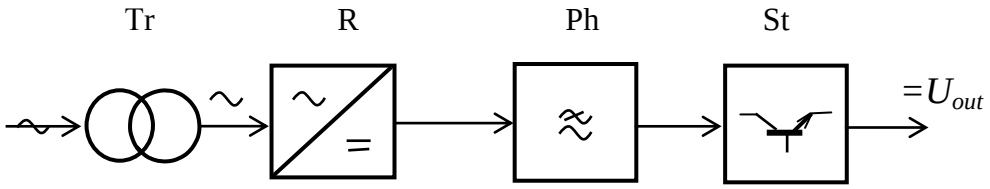
Generalise structure SPS shown on ill.1. Input voltage of alternating current 220 In changes a transformer (Tr) to the necessary value (for instance, 6 V), is rectify (R), is filter (Ph), but afterwards , is as required stabilize by the stabilizer of direct current (St). Load is connect to leaving a stabilizer. Transformer at the input SPS ensures and galvanic uncoupling between the network primary електропитания and load.

Quality SPS characterizes a pulsation factor on the load:

$$k_n = \frac{\Delta U_н}{U_2},$$

where $\Delta U_н = U_{2\max} - U_{2\min}$; U_2, U_{2max} , U_{2min} – necessary constant , pulsed maximum and minimum voltage on the load accordingly.

Usually k_n = 0,05 – 0,2.



Ill.1. Structure chem SPS with transformator input

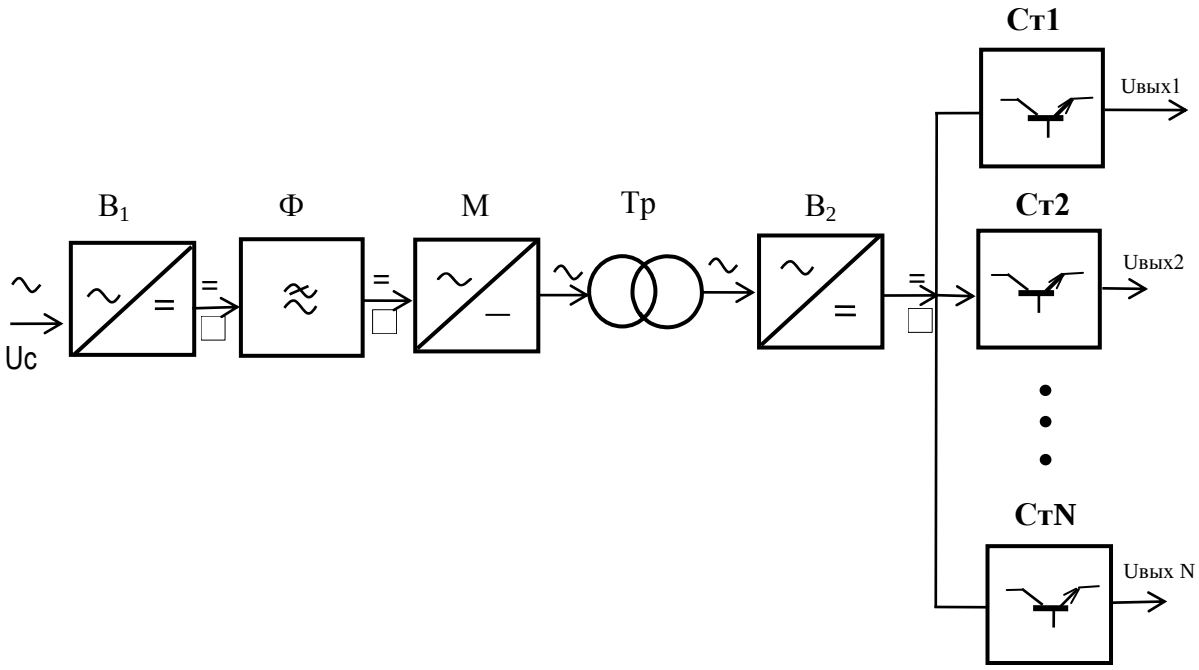
Low frequency to network 50 Hzs brings about need of using the bulky transformers and filters , at pulsation factor on leaving a filter depends on values of

load and often turns out to be inadmissible big. Coefficient Of Efficiency (CUE) such SPS is equal an attitude powers, which will be return beside loads Рн to powers P1, потребляемой from the primary electric network CUE = Рн/P1, as a rule, not above 40 %.

Development of electronic technologies has bring about making an element base, which allows principle to perfect technical-econmic factors SPS in the broad range of powers. Herewith revolutionary influence upon features SPS has done a making the high-tension radio-frequency electronic keys, optrons and other electronic instruments, which allow to transform an electric power not on frequencies of primary electric network 50 Hz, but on frequencies 40 = 250 kHz. And base structures SPS are change Accordingly. Main constant "бестрансфор-маторная" structure SPS (ill.2), accordingly which voltage to network 220 V is just rectify by the diode rectifier (VD1) and is filter by lowfriquence filter (Ph). Received constant voltage (about 305 V) changes a generator (G) in the pulsed current with the increased pulse frequency (before 200 kHz), that afterwards , than help of pulsed radio-frequency transformer Tp will be transform in the variable voltage of needed amplitude. Voltage of secondary winding of pulsed transformer TP is rectify by the rectifier (B2) and is stabilize by the stabilizer Sт1.

Radio-frequency transformer has small sizes and ensures a galvanic uncoupling between entry and output SPS before 5 kV. Source pulsed voltage of increased frequency afterwards is again rectify by means of the most simplest single-phase diode rectifier and is filter by the simple filter of low frequencies, which usually constitute of capacitors of big capacity (before 1000 mF, 500 V). Perforce amount of secondary windings of pulsed transformer can be increased (St_1, St_2,...,Ct_n) for getting a necessary composition of secondary voltages U_{out1} , U_{out2},...U_{outN}. Stabilization of source voltage is ensured by changing a width of pulses of generator, so such schemes have get a width-pulse modulator name (WPM) [3,5].

At present several companies (Power Integrations, FranMar, Peak, Lambda, Ericsson) release AC/DC converters with microcircuits WPM differentpower from 0,5 Wt before 50 Вт, moreover converters by the power before

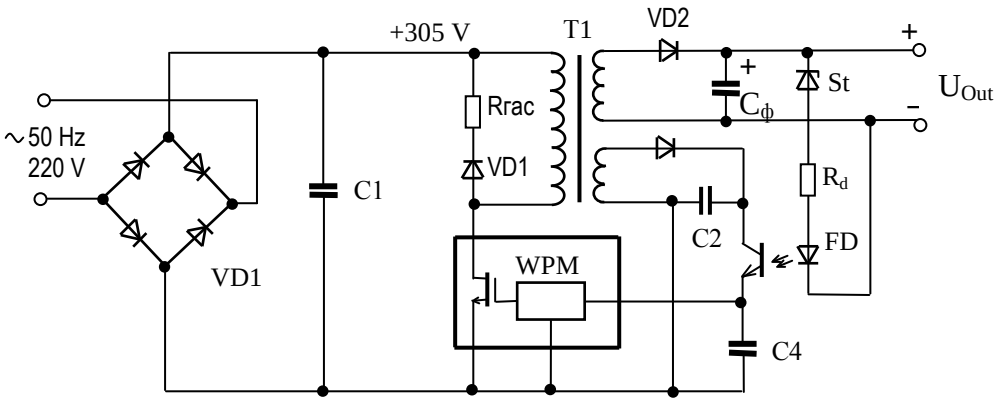


Ill.2. The structure SPS without transformator input

6 Wt are executed in bodies DIP-8 , DIP-8B, or in planar execution – a body SMD-8B. Converters of power before 25 Вт are release in square-wave bodies 50x25 mm, height 10–15 mm, but powers 25–50 Wt = in bodies 50x50mm or 25x75 mm.

Majority AC\DC – converters are executed on the scheme of direct transformation of direct current (ill.3). In this scheme input and source windings are locate on general magnet conductor of reactor, executed from ferro=alloy. Galvanic uncoupling is ensured by presence of two windings. Rectifying is ensured by the diode rectifier (pulsed diode VD2) and filter of low frequencies (C_f).

As rectifiers are to be used bridges and half-bridges scheme, level of pulsations which nearly double lower, on output an однополупериодной scheme. The first generations describe above converters were create on the base of bipolar transistors, which work at frequencies several kHz from rather low CUE (50–60 %) Accordingly and specific mass– dimensions factors such SPS did not exceed 300 Wt\dm^3. Main factors, which limit an increasing these factors, were low features of filters on such frequencies and greater коммутационные loss of power in transistors.

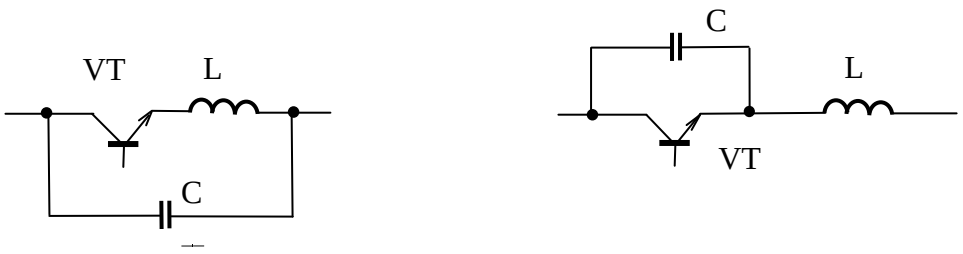


Ill.3. Base pulse AC/DC converter chem

Attempts to reduce these losses an introduction RLC- chems ("snobers"), which do a quicker process of switching a transistor, are render insufficiently efficient, since "snobers" themselves create the losses of power. Situation is perfect with the appearance of powerful field transistors, which are distinguish by the high speed and practically zero power of pulses of control. As a result of become a possible making a new generation of converters with "mild" switching of keys at moments, when current or voltage on the transistor close to the zero. Converters of new generation were named "kvaziresonance" [1]. In turn they are distinguished on two classes: converters with the switching in the zero of current (SZC) and converters with the switching in the zero of voltage (SZV) [3].

Principle of action of such converters based on introduction beside converter schemes LC-sidebars, which when switching the keys create kvazisinus fluctuation, which allow to switch off a key in the zero of current or include a key in the maximum of voltage (ill.4) [1,5]. These keys can be effectively use in base schemes SPS. For converters by the power 100 Вт reach specific features 930 Wt/dm^3. High efficiency of this type of schemes stipulate practically by excluding the losses when switcing off. Herewith limiting frequencies for converters from SZC be a frequency 2 MHz, most further its increase is limited by losses transistors.capacities.

Converters with SZV are to work at radio frequency (before 10 MHz). As far as at a moment of switching a collector–emitter voltage $U_{кe}$ of transistor close to



а б

Ill.4. Resonance switches:

а – with the switching in the zero of voltage ; б – with the switching in the zero of current

the zero, on recharge capacities of transistor an energy nearly does not get lost. Besides, as far as voltage, which is commute, small (2–3 V) , pulsed voltage of hindrances, which is created in network of alternating current 220 V, also has a minimum amplitude.

At present квазирезонансные converters by the power before 100 Вт are created on the base of hybrid thick-film technology. Converters of small power (before 10 Вт) are release in 8-excretory and 14-excretory DIP-bodies.

Findings

For raising CUE and efficiency of pulsed converters necessary to use квазирезонасные sidebars when using radio-frequency MOS-transistors.

Converters of voltage by the power before 300 Wt with the switching in the zero of voltage are to work at frequencies before 10 MHz. Herewith practically are equal a zero of loss at switchings, stipulate "stray" capacities MOS-transistors, that обуславливает high CUE (before 87%). Simultaneously falls a hindrance level, create by the pulsed converter in network of alternating current.

Literature List

1. Li F.K. Radio-frequency kvaziresonance converters / F.K.Ls / ТИИР.–1988. –V.76 - №4. – P.12–14.

2. Rosanov Y. The Secondary power sources: from the network transformer to the patch of factor of power / Y. Rosanov, M.Ryabchinskiy, A.Kvasnyk / Chip News Ukraine. – 2004. – №4. – P. 3–8.

3. Kasatkin A.C. Course of electrical engineering / A.C.Kasatkin, M.V.Nemtcov. - M.: "High school" , 2008. –2005. –542 p.

4. Stupelman V.C. Semiconductor instruments / V.C. Stupelman, G.A.Filaretov. - M.: "Sov. Radio", 1973. –248 p.

5. Samoilov V.F. Pulsed technology / V.F. Samoilov , V.G.Makoveev. – M.: Publishers "Relationship", 1971. – 224 p.