Summaries of publications

of **Daniela Mareva**, assistant Power electronics, Ph.D.
in the field of electrical and electronics engineering

Monograph

P1. Mareva D. "Semiconductor converters in electric arc welding" Ongle-Varna, 2021, ISBN 978-619-7373-95-0. Reviewer: Prof. Dr. Angel Toshkov, BSU.

Welding is the main method for joining metal parts, and electric arc welding has a leading role in welding production. The rapid development of power electronics and microprocessor technology has provided new opportunities for obtaining new technological advances and a qualitative leap in welding.

The progress made in recent years in the field of welding machines has helped to achieve the required quality of the welding process. The high speed and high power of modern semiconductor devices allow their use in welding machines with automatic control of welding technology. The monograph describes the technical and technological development of energy sources for arc welding, which allows to understand the welding technology, classification of different methods, technology of manual electric arc welding, the device and requirements for energy sources. of the welding arc.

The welding sources have been qualified and the requirements for them have been considered.

In item 3 of the monograph the conventional welding sources are considered in sufficient detail - welding generators, alternating current welding sources and rectifier welding units.

Together with the theoretical schemes of the electricity converters used in welding, real industrial schemes of Bulgarian and foreign welding units are considered. In item 4 of the monograph more attention is paid to inverter sources for welding, nature, features, overview of circuit solutions. These are the new trends in welding in the field of thyristor and transistor power electronic converters. Valuable information is given about the peculiarities of the individual schemes used in welding.

In item 5 are given own developments of the author or with a team in the field of inverter current sources for welding.

The following conclusions can be drawn from the research:

1. The studied circuit of a two-stage inverter welding source shows normal functional suitability during operation of both inverters.

2. The output voltage at idle is 2 ÷ 3 times higher than the voltage in the presence of an arc.

3. Idle operation does not load power transistors $T_1 \div T_4$.

4. PWM regulation in welding mode provides the required value of the welding current.

5. PWM regulation in idle mode does not significantly affect the output voltage and load of the transistors.

6. Due to the large difference between the maximum and average value of the voltage after the output rectifier, pulse-arc welding is realized without an additional current source.

7. The energy characteristics of the pulse are determined by the value of the pulse

capacitor and the magnitude of the welding current.

8. The pulse tracking interval is determined by the control device according to the type of welded material.

9. The investigated scheme of inverter source for pulse arc welding shows normal functional suitability with the possibility to adjust the parameters of the current pulse in a wide range.

10. The shape of the current pulse weakly depends on the frequency of repetition of the current pulse.

11. The energy characteristics of the current pulse are regulated stepwise with a change in the value of the pulse capacitor, and the fine regulation of the drip frequency is carried out by changing the frequency of the pulses. The pulse width does not affect the amplitude of the current pulse.

12. The shown mode of operation of the parallel capacitor CP with the oscillating capacitor CK significantly reduces the dynamic loads in the circuit elements.

13. In idle mode, the inverter operates at minimum load, thanks to the parallel capacitor, which produces its own resonant frequency several times higher than the resonant frequency in operating mode.

14. The regulation of the welding current and voltage must be done by changing the quality factor Q within small limits.

15. The applied methodology sufficiently accurately measures the values of the resonant components.

16. The regulator of welding current, realized with power transistors allows to realize multi-station welding unit.

17. The proposed scheme has very good controllability of the welding current.

18. In case of higher welding currents it is necessary for the building elements - transistors, diodes, coils to have a small resistance in the right direction.

19. The autonomous voltage inverter and the element base allow to realize a multi-station welding unit, especially convenient in the application of robotic welding units (gas pipelines, electric motors, etc.).

20. The proposed scheme has very good controllability of the welding current in centralized or decentralized control.

21. With the centralized control of the welding unit a lighter mode for the inverter is obtained.

22. The use of a small soft start coil at the inverter input and an RC circuit included in the diagonal of the bridge improve the performance of the inverter. The improvement consists of: reducing the stress overload and preventing the transistors from overvoltage.

23. Increasing the efficiency of the scheme.

Contributions to the monographic work

- The monograph makes a classification of welding methods, different types of welding units, their characteristics and features and shows and explains the main types of schemes of actually operating ones.
- The advantages and disadvantages of the applied schemes are shown.
- Conventional welding sources are given, which were mass-produced a decade ago, but are unlikely to be produced anymore, but will continue to be used in many places. Particular attention is paid to inverter welding sources.
- Transistor inverter welding machines have specific features that are manifested in the selection of a suitable circuit, elements, control and regulation system. The monograph gives 6 scientific developments of the author or a team of inverter welding sources, and each

development decides some improvement in the quality of welding.

- Pspice models of the power part of the schemes are made, their work is studied and researched.
- Innovations and improved nodes of some schemes are proposed.
- Their efficiency, energy characteristics and subsequent improvements are studied.
- The methods and schemes for improving the switching characteristics of the converting devices are considered.
- Formulas for calculation of individual elements are also proposed, on which the characteristics of the circuit solutions depend.
- Improvements in these characteristics can be seen from the conclusions.
- The methods for research and analysis of welding devices can be used successfully in the analysis of other electronic power devices. The obtained results and analytical dependences can be used in sizing of welding units.
- Further development of welding units will continue the trend of increasing the operating frequency, reducing the weight and dimensions of devices and improving the quality of welding. This will be due to the improvement of the building element base.

Scientific publication in publications that are referenced and indexed in world-famous databases of scientific information

P7. Vencislav C. VALCHEV1, Daniela J. MAREVA, Dimitar D.YUDOV, Nikolay L.Hinov „Comparison of Power Converters for LED Illuminants“ - TEM Journal, May 2018, Vol.7, No 2 , Serbia,pp 398-404,

The purpose of the paper is to investigate the various modulation types for control of transformer less non-dimmable AC/DC/DC converters in nominal operation mode intended for LED illuminants. A combined PWM (pulse width modulation) is investigated. The optimal selection of power converter inductor core is considered. The derived results lead to conclusions for improvement of the power converter characteristics. Furthermore, the DC link capacitor is reduced without significant effect on circuit performance. It is proven that utilizing combined PWM would result in less current ripple and improved power factor. Utilization of nanocrystalline materials reduces losses additionally in the examined power converter.

The first order and the high order harmonics of the current, consumed from the grid, are obtained for conventional PWM with 50kHz switching frequency and for the combined input current modulation.

The harmonics amplitude reduction when using combined PWM to drive the power converter can be clearly noticed. A comparison between both types of modulation: BUCK I with conventional 50 kHz PWM and BUCK II with combined PWM.

Up to 10 % and more reduction is available at the 4^{th} harmonic which indicates an improvement in quality factor. This is extremely important especially with the elevated requirements for quality of the consumed energy, which is monitored by different government organizations.

Optimizing the design of the inductor in the circuit is closely related to an optimal choice of the magnetic material for core. The compared materials are: ferrites , powder materials and amorphous materials Design recommendations are derived based on the well-known Fast Design Approach.

Further, nanocristalline materials have to be considered (VITROPERM500, NANOMET, FINEMET ets.). The advantages of the nanocrystalline materials are that they

combine both high permeability typical for amorphous materials and low losses of ferrite materials; using them allows reduced size and weight of the components and the material reveals high aging stability and reliability.

Final design recommendations are derived based on the comparison of three different materials for cores:

- DC choke design based on ferrite cores leads to higher copper losses and thus, deteriorated heat transfer reduced the design optimization;
- DC choke design based on powder type toroid - core losses are dominant;
- Using nanocristalline cores provides decreased losses and volume, but the price is higher.

The different modulation types for transformer less non-dimmable LED driving AC/DC/DC power converters are investigated in nominal operation mode. The following conclusions are made based on the simulation analysis:

1. The high frequency switching of the power converter allows proper operation of the output filter with lower filtering capacitor values;
2. The utilization of combined PWM type results in lower ripple and better power factor;
3. The utilization of nanocrystalline materials allows additional reduction of the losses in the investigated power converter.

The obtained results lead to possibilities to improve the characteristics of the investigated power converters.

P10. V. C. Valchev, D. J. Mareva, D.D. Yudov and R. S. Stoyanov Inverter Current Source for Pulse-Arc Welding with Improved Parameters , MIPRO, 2017, 40-th Jubilee International Convention May 22 – 26, 2017, Opatija, Croatia, pp 138-143, ISSN:1847-3938

The feature of power current sources for pulse-arc welding is superimposing of current pulses with a defined shape, size and frequency on the main welding current. The purpose of this paper is to explore the possibilities to control the parameters of superimposed pulses by a particular (additional) welding inverter current source with improved parameters. The current pulse superimposed to the basic current has duration of (1.5 ÷ 3.0) μs and is realized by an additional source. The operation and the characteristics of the scheme are investigated by simulations (Pspice) under various modes and loads. The formation and separation of the drop from the end of the electrode is controlled by the amplitude and duration of the pulse current. Thus, the average welding current can be significantly reduced. Dependences of the parameters of pulses on specific components of scheme are derived. Recommendations are made to improve the performance and utilization of the circuit elements and the technological process. Design recommendations are presented to optimize the parameters of the transformer.

The advantages of welding inverter sources operating at high frequency are well known. A possible approach of further increasing their performance is the pulse arc-welding. This method is very advantageous with non-ferrous metals and stainless steel.

The pulse arc-welding current sources operate based on a simple principle. Additional current source superimposes a current pulse with defined form, amplitude, power and frequency over the main welding current. The requirements for the current pulse are "solid" or "falling" external V-A characteristic. The polarity of the welding current significantly affects the welding process. The management of the transfer of the metal in this method is been enforced to varies between two levels of current, called base (I_z) and current pulse. The current

amplitude is selected based on the requirement to ensure the continuity of the arc with small impact on the melting of the electrode. The function of the pulsating current exceeds the critical current for melting the tip of the electrode and form droplets of a certain size and droplet detachment from the end of the electrode under the action of electromagnetic force (pinch effect). An optimal transfer the metal is considered when only a single drop of the metal electrode is formed for each current pulse. The drop formation and separation is controlled by the amplitude and duration of the pulse current, and the average welding current can be greatly reduced (reduction in the frequency of the current pulse or reduction of the base current).

The high frequency (for control of the transfer of the metal) and low frequency (for control of the formation of cavity) pulsating currents are used simultaneously and serve as a basis for the consolidation of this process as "double pulse". The current pulse superimposed over the base current of the arc has duration of (1.5 ÷ 3.0) μs. This current is produced by additional source connected in parallel with the welding source. Simultaneously a high-frequency control (the transfer of the metal) and a low frequency one (for control of the formation of cavity) are performed to obtain so called "double pulse".

This paper is focused at exploring the possibilities to adjust the parameters of the superimposed pulses on a particular hardware implementation.

The studies presented are realized by computer simulation. The models of power semiconductor switches (IGBT, diodes) are based on models provided by the corresponding manufacturers.

The maximum current value changes linearly in small limits (up to 5μs) corresponding to the pulse width, alongside the change of the capacitor value. Furthermore, the form the pulse is maintained, and the amplitude is regulated smoothly. It can be controlled evenly up to a maximum of 60 A.

The purpose of this paper is present and studies the possibilities to control the parameters of welding process with superimposed pulses by a particular (additional) welding inverter current source with improved parameters. The current pulse superimposed to the basic current has duration of 1.5 ÷ 3.0μs and is realized by an additional source. The operation and the characteristics of the scheme are investigated by simulations (PSpice) under various modes and loads.

The following conclusions are derived based on the carried out simulations and designs:

• The pulse-arc welding inverter current source studied in the current paper shows significant prospects in functionality. The scheme is capable of regulating the parameters of the current pulse in a wide range.

• The form of the current pulse slightly depends on its frequency.

• The energetic characteristics of the current pulses are controlled stepwise by changing the value of the pulse capacitor. Precise control of the frequency of the drop separation is performed by changing the frequency of the pulses. Pulse width does not affect the amplitude of the current pulse.

• Three different transformer designs are realized and compared. The best parameters are obtained using a EE ferrite core. Design with a PM ferrite core provides improved EMC parameters as the windings are completely inside the core and fringing field is minimized.

The experimental results are envisaged in the future publications. The accuracy of the simulation results is high as the simulation results are obtained utilizing manufacturer's models of the semiconductor devices (IGBTs, diodes).

P12. Dimitar YUDOV, Vencislav VALCHEV and Daniela MAREVA "Emergency procedures in invertor for induction heating of fluids"- XIX- th International Symposium on Electrical Apparatus and Technologies SIELA 2016, 29-1 June 2016, Bourgas, Bulgaria digest pp.231-234, ISBN 978-619-160-648-1, pp.378, ISBN 9781467395236

The paper presents investigation and analysis of the deviation of operating parameters of an resonant inverter for induction heating of fluids and resulting possible emergency situations (cases). Full study of 4 different emergency cases of the considered induction heating inverter is presented. The over currents through the switches are found, as well the slope of the current rising. An approach to protect the inverter in cases of emergency is proposed including an additional inductance LF in series with the input DC voltage source. Analytical derivation of the value of LF is presented, considering the power of the inverter, the switching parameters of the switches and set values of limits of the over currents.

The operating conditions of induction heating equipment are quite heavy because of dust, moisture, vibrations, electromagnetic interference. These conditions lead to deterioration of operating parameters and shortening the life time of the electronic equipment (power inverter) under stress.

The purpose of the paper is investigation and analysis of the deviation of operating parameters of an inverter for induction heating of fluids and resulting possible emergency situations (cases). The voltage and current overloading of the electronic components is studied under such conditions and proper solutions are presented for decreasing the component stress.

The possible emergency cases of an inverter for induction heating of fluids are investigated analytically and by simulations, PSPICE. The over currents through the switches are found, as well the slope of the current rising. It was found that in the emergency cases the voltages are in the limit, but the currents through the switches are above the limits.

An approach to protect the inverter in cases of emergency is proposed including an additional inductance L_F in series with the input DC voltage source. The influence of L_F is studied analytically and by simulations. The value of L_F is more than 10 times lower of the total value of L_{k1} and L_{k2}, thus there are no influence on the normal operation of the inverter. The protective effect of L_F is proved.

Design considerations are proposed for calculating the value of L_F in correspondence with the power of the inverter, the switching parameters of the switches and set values of limits of the over currents. The analytically calculated values of the short currents are proved by the simulation results.

P13. Vencislav VALCHEV, Dimitar YUDOV, Daniela MAREVA and Teodora TODOROVA "Design considerations of inductors for induction heating of fluids"- XIX-th International Symposium on Electrical Apparatus and Technologies SIELA 2016, 29-1 June 2016, Bourgas, Bulgaria, digest pp.217-219, ISBN 978-619-160-648-1, pp.356, ISBN 9781467395236

This paper presents a design methodology for an inductor for induction heating device. The proposed design algorithm provides optimal selection of the inductor pipe, size and dimensions. Electrical parameters of the coil are also derived. The main steps of the design procedure are described. The methodology steps are in accordance with the specific assigned operating parameters and the geometric dimensions of the inductor. Specific design recommendations are proposed: considering skin effect at the selection of the width of the piece and calculating in accordance with the operating frequency; eddy current losses in the

coil could be decreased using Litz wire or a few wires in parallel. The results of the simulations of the inductor operation, using FEM analysis prove the derived recommendations.

Induction heating of fluids is often used in industry as well in domestic appliances. Proper construction and high efficiency of the power electronics stage and the inductor itself are decisive for reaching good operating parameters of the system. An induction heating system consists basically of one or several inductors and feromagnitic pipes to be heated. The inductors are supplied with alternating current which induces eddy currents inside the component being heated. Numerical and FEM modelling of induction heating is presented.

The paper presents an improved design methodology for dimensioning an inductor for induction heating. Two different constructions are considered: cylindrical one and improved one with higher efficiency.

This paper has focused on the pre-design of an inductor for induction heating. The proposed design methodology provides optimal selection of the inductor pipe, size and dimensions. Electrical parameters of the coil are also derived. The input parameters of the calculations are in accordance with the specific assigned operating parameters and the geometric dimensions of the inductor. The main steps of the design procedure are described. Specific design recommendations are proposed:

- The skin effect (relocation and concentration of the current density to the surface of a conductor at high frequencies) has to be considered, thus the width of the piece has to be calculated in accordance with the operating frequency.
- Eddy current losses in the coil could be decreased using Litz wire or a few wires in parallel.

Scientific publication in unreferred journals with scientific review or in edited collective papers

P2. Mareva D. " Energy characteristics of an electronic transformer " - Международна научна конференция по случай 30г от създаването на БСУ „ „Съвременни управленски практики XI - Интелигентната специализация в десетилетието на свързаността и автоматизацията", (4-5 юни 2021г.), БСУ, стр.59, ISBN 978-619-253-003-7

Sometimes it is necessary to work with alternating voltage, the value of which is different from the mains voltage.

However, transformers and autotransformers are heavy and expensive equipment. For this reason, they are being replaced by electronic AC transformers. The function of electronic AC transformers is to provide an output voltage with a shape close to sinusoidal and with a frequency equal to the input. In addition, these devices provide smooth regulation of the output voltage, zero consumption in idle mode and therefore high efficiency, low weight and dimensions, the possibility of current protection and more.

The purpose of this article is to investigate the energy characteristics of a thyristor AC / AC electronic transformer.

Conventional power supplies are built on the basis of low-frequency transformers and low-frequency control, and this leads to large sizes and corresponding weight of the power supplies themselves and high material consumption of already expensive metals. The latest innovations in the field of power electronics make it possible to create new converter power supplies with intermediate conversion, which use higher operating frequencies and high-

frequency transformers.

The required value of the output power can be provided at the input voltage Ui and regulation angle α from 0 to 90 degrees. Implemented smoothly by parabolic law. This provides stable power to the load by adjusting the steering angle, which compensates for changes in the supply voltage.

1. The aging power distribution network, the addition of new residential capacity (air conditioners, etc.), poor and insufficient prevention and maintenance, the constant fluctuation of the mains voltage increasingly sharpen our attention on this issue. The developed converter is particularly suitable for providing independent voltage to the load where the supply network is significantly unstable.

2. By changing the control angle, a constant output voltage and power can be achieved, regardless of changes in the voltage coming from the mains.

P3. Mareva D. „Regulation of the output power of autonomous resonant inverters ” - Електронно списание "Компютърни науки и комуникации", том VIII, книжка 1, първи брой, 2-9 стр., ISSN: 1314-7846, БСУ, Бургас, март, 2021

The paper presents the conception and analysis of schematic realize autonomous inverter supply for different applications. At sources of induction heating of fluids is the most popular serial full bridge resonant inverter. To regulate the temperature of the inverter use the method of frequency control of the output power. In this method, the elements composing the resonance circuit having constant parameters. Operating frequency is changed, to afford a smooth adjustment of the output power of the induction heater.

In most of the described cases, it is necessary to adjust the output voltage, output power in order to change the temperature, brightness and other indicators of the object powered by the inverter. This effect is generally obtained by adjusting the mode of operation of the resonant inverter. The resonant inverters used in the cited applications are:

- depending on the type of power supply - with open or closed input (voltage or current);
- depending on the type of circuit - bridge, half-bridge or with a midpoint of the transformer.

The article discusses in detail a resonant bridge voltage inverter, and the results obtained with a certain coefficient of equalization are valid for all circuits of resonant inverters with open input.

The required temperature released in the fluid has a smoothly changing character, with a change in the operating frequency f_{sw}. When the water flow, rate changes, the graphs run in parallel, increasing at higher frequencies.

1. The series resonant inverter shows good control characteristics when used in fluid heating systems.

2. The current and voltage shapes of the transistors remain close to sinusoidal at wide limits of regulation.

3. The efficiency does not change in a large range (0,88 to 0,93) and satisfies the requirements for induction heating of fluids.

4. The results obtained for the resonant inverter powered by a voltage source can be successfully applied to the technological applications of the resonant inverter described above.

P4. Dimitar Yudov, Mareva D - "Energy characteristics in multiple inverter welding source " Международна научна конференция „Дигитални трансформации, медии и обществено включване", (5 юни 2020г.), БСУ, стр.419-431, ISBN 978-619-7126-92-1

Inverter welding sources are replacing conventional sources due to their convincing advantages - small size and weight, easy ignition and high quality of the arc, high energy and economic performance, operation in all conditions.

The rapid development and implementation of transistor welding inverters became possible after the development of suitable power transistors (JGBT).

Multi-station welding sources have more power than conventional welding sources. This places higher demands on their energy performance, which requires very precise design and selection of the element base.

The purpose of this article is to study the energy performance of a multi-station inverter-welding source associated with switching losses at different welding currents.

Multi-station welding sources, depending on the method of welding current regulation, have 3 operating modes:

a) centralized control - the width of the control pulse of the inverter tui-var. changes, and the control pulses of the welding regulators do not change - tur_1, tur_2 = const.

b) decentralized control - the width of the control pulse of the inverter tui-const does not change, and the control pulses of the welding regulators change - tur_1, tur_2 = var.

c) mixed - the width of the control pulse of the tui-var inverter changes and on the welding regulators - tur_1, tur_2 = var.

The first study was conducted under centralized management. The centralized control is used in robotic complexes - welding of stators of electric motors, gas pipes, etc.

The influence of additional protective chains consists in:

1. The rate of increase in current (di/dt) and voltage (du / dt) increases, which leads to an increase in the stress load of the active elements of the circuit.

2. In terms of energy, this does not affect the operation of the inverter.

The following conclusions can be drawn from the research:

1. The autonomous voltage inverter and the element base allow to realize a multi-station welding unit, especially convenient in the application of robotic welding units (gas pipelines, electric motors, etc.).

2. The proposed scheme has very good controllability of the welding current in centralized or decentralized control.

3. The centralized control of the welding unit results in a lighter mode for the inverter.

4. The use of a small soft start coil at the inverter input and an RC circuit included in the diagonal of the bridge improve the performance of the inverter. The improvement consists of:
- reduction of stress current overload and protection of transistor overvoltage.

5. Increasing the efficiency of the scheme.

P5. Mareva D." Energy characteristics in welding current regulators" - Международна научна конференция „Дигитални трансформации, медии и обществено включване ", (5 юни 2020г.), БСУ, стр.477-484, ISBN 978-619-7126-92-1

Welding current regulators are used in multi-station welding units, which are used in robotic welding complexes, for example when welding stator packages of electric motors, or large gas pipes in which it is simultaneously welded with 2-4 burners.

The rapid development and implementation of inverter welding sources became possible after the development of suitable power transistors (JGBTs) and transistor modules.

Multi-station welding sources have more power than conventional welding sources. This places higher demands on their energy performance, which requires very precise design and selection of the element base.

The purpose of this article is to study the energy performance of transistor welding current regulators to obtain good energy performance.

The object of the study is a welding current regulator.

The research is carried out with a computer simulation. The PSPICE model of a welding current regulator has the form (Fig. 2).

In multi-station welding units, the current regulators (PT) are 2 or more in number and each of them can individually regulate the value of the welding current from 20A to 250A.

The study of the shown circuit is realized by a PSPICE model of the equivalent replacement circuit of the inverter welding source, and additionally in the PSPICE model the active losses in the reactive elements are taken into account.

The voltage on the blocked transistor is equal to the value of the supply voltage, which means that there is a very good coefficient of voltage of the transistor. It can be seen that the maximum voltage on the transistor is around the supply voltage V (1), and the current is rectangular in shape and its average value varies widely.

The following conclusions can be drawn from the research:

1. The welding current regulator, realized with power transistors, allows to realize a multi-station welding unit.

2. The proposed scheme has very good controllability of the welding current.

3. In case of higher welding currents it is necessary for the building elements - transistors, diodes, coils to have a small resistance in the right direction.

P6. Mareva D „Tendencies in the operation of inpulce arc welding“- INTERNATIONAL SCIENTIFIC CONFERENCE „BLUE ECONOMY AND BLUE DEVELOPMENT“, Bourgas Free University, 1-2 June 2018, Bourgas, pp163-169, ISBN 978-619-7126-57-0

The trends in the development of the modern sources of energy used in electro-arc welding in a protective gas environment are analyzed. Various types of metal transfer and the ability to control this process by changing the welding current parameters are considered. The prospect of arc welding in the protective gas environment is justified.

Fusion welding (in the liquid state) is the most common and universal method. In this method, the metal is brought to a liquid state at the welding site by a concentrated heat source. Only the ends of the welded parts melt. Welding can be performed by melting the metal of the joined parts, the so-called. parent metal, or by melting the parent metal and ancillary metal added in the form of wire, rod, strip or other form. In practice, the second option is mainly used. The molten base or base and auxiliary metal form a welding bath. When the heat source is removed, the metal of the welding bath cools and crystallizes. In practice, the heat source moves at a certain speed longitudinally along the welded ends.

Characteristic of the considered group of methods is the use of concentrated heat sources operating in a limited area. They cause the necessary heating to form the welded joint and meet certain technological requirements of the welding process:

- the energy source must operate in a precisely defined area of the volume or surface of the product;

- the power of the source must be large enough to be able to compensate for heat losses in the adjacent (cold) parts of the metal and in the environment when the specified volume of metal is heated to the required temperature;

- the specific power of the energy source (power per unit volume or unit area) must exceed a certain value, depending on the properties of the material or the shape and dimensions of the welded product.

Accurate dosing of heat energy during welding is very important. On the one hand, maximum power must be sought to increase productivity, and on the other hand, metal overheating or metallurgical processes in the bath must not be allowed to lead to undesirable consequences.

The power supplies for the welding arc must meet the following requirements:

- the no-load voltage (voltage at the output terminals of the current source with the welding circuit open) must be sufficient to ignite the arc, but must not exceed the value safe for the welder 80 V;

- the power of the current source must be sufficient to supply the arc with the required value of welding current;

- the power supply of the arc must have a device for smooth regulation of the current within the necessary limits for welding;

- the power supply of the arc must have a small mass, size and low cost and be convenient to operate.

The source is selected depending on the volt-ampere characteristic of the arc, corresponding to the accepted method of welding.

A source with a steeply falling external characteristic is used to supply an arc with a solid characteristic.

The combustion mode of the arc is determined by the point of intersection of the characteristics of the arc and the source.

Many of the characteristics of the gas welding process depend on the type of metal transfer itself and the molten electrode.

The nature of the arc is significantly influenced by different types of characteristics, such as: heat balance, spatial stability, size, intensity of metallurgical flow reactions in the welding zone, loss of vapors and splashes, and penetration depth, shape and parameters of the seams.

There are several types of metal transfer in a gaseous electrode, the main of which are:

- transmission with small or large drops with short circuit (SC) of the arc in the gap in shielding gas;

- transmission with small or large drops without short circuit of the arc in the gap and jet process in shielding gas;

- return jets in shielding gas;

- transfer of a pair of metals of small or large size in a shielding gas.

The following conclusions can be drawn from the research:

1. The electric equipment for arc welding with melting electrode in shielding gas realizes the main types of metal transfer from the electrode, as other transitional types of metal transfer have been developed.

2. The control of the pulse-arc process is used effectively in welding a wide range of metals, as well as many combined technologies.

3. It has been established that the development of modern welding equipment, realizing the transfer of metal from the electrode, is ensured by controlling the pulse-arc welding process itself.

P8. Mareva D „Selection of transistors depending on their application in power circuits“ ”- Годишник, том XXXVI , Бургас 2017г., стр.195-200, ISSN: 1311-221X

The building blocks of high-power controls are power switches. Their main parameters are the limit voltages and currents, as well as the speed and efficiency of energy transfer.

The purpose of this article is to show the applications of transistors operating above 250V, with a switching frequency between 10 kHz and 200kHz and powers above 500W. The final choice of a power semiconductor device is based on various factors: thermal resistance, current topology, conductivity distribution.

Circuits using zero switching voltage (ZVS), power factor correction (PFC) fall on both types of IGBT / MOSFET devices. Hard-switched applications clearly show lower MOSFET losses.

The losses in IGBT are approximately equal to the losses in some previous generation MOSFETs if the switching speed is reduced to 50 kHz. This allows smaller IGBTs to replace larger MOSFETs in some applications. MOSFET PT7s have about 30% lower shut - off losses compared to the best MOSFETs on the market and lower TRR and QRR.

The low QGD / QGS ratio improves the reliability of the inverter and is applicable to offline UPS inverters. Switching power supplies (SMPS) are undergoing revolutionary changes in increasing power density, efficiency and reliability.

They have topologies and concepts in powerful circuits that are combined with improved semiconductor devices with low power loss. Phase shift (PS), pulse width modulation (PWM), zero voltage switching (ZVS), bridge circuits (FB) and LLC resonant inverter topologies use FRFET as powerful power switches. Typically, an LLC resonant circuit is used for lower power, and PS-PWM-FB-ZVS for more powerful applications.

P9. Mareva D „Application of new generations of power MOSFETs and IGBT depending on their application“ ”- Годишник том XXXVI , Бургас 2017г., стр.246-250, ISSN: 1311-221X

In semiconductor power converters operating at higher frequencies, the determination of losses in power semiconductor valves is of particular importance. The resonant and quasi-resonant switching of the valves allows to reduce these losses and to increase the range of operating frequencies of the electronic devices, increases the reliability and improves the electromagnetic compatibility from the network and to the load. The operation of power transistors in powerful voltage inverters and switching at zero voltage have features that must be taken into account and require the use of special control methods.

The requirements to the power factor PFC for regulation of Boost pulse converters are:

1. Low values of the parameters QGD, RSP, QGD and CGD, which are especially important in influencing the switching speed. Low values of the CGD and QGD parameters reduce switching losses, and low RSPs reduce conduction losses.

2. Low values of the COSS capacitor reduce switch-off losses, hard switching loss and switching in ZVS mode.

3. Low values of the CISS capacitor reduce the power in the driver gate at PFC and usually operates at a frequency above 100KHz.

4. Protection against high steepness of the pulse dv/dt and allows for reliable operation.

5. The UTHGS gate voltage with a value of (3 ÷ 5V) helps in the parallel connection of the MOSFET and provides protection against re-applied steepness of the pulse dv/dt.

6. Sudden changes in parasitic capacitances in MOSFET transistors during dynamic switching can cause oscillations in the gate that increase the voltage across it. This can affect

long-term reliability.

7. The ESR of the gate is an important indicator because a high ESR can increase shutdown losses, especially in ZVS mode.

P11. Mareva D., Юдов Д. ” Energy efficiency of an inverter source for induction heating of fluids ” - Юбилейна научна конференция с международно участие „Новата идея в образованието”, (20-21 септември 2016г), БСУ, Бургас, томII, стр.535-544. ISBN 978-619-7126-28-0

A circuit of an inverter for heating fluids with a combined structure, improving the operation of the inverter, using the advantages of an inverter in current and voltage, is considered.

With proven functionality of the studied circuit in a wide range of variation of the output power with a high efficiency, the losses in the rectifier and the inverter in nominal mode are considered.

Inverters used in the practice of induction heating of fluids use powerful power switches based on MOSFETs or IGBTs transistors. The simulation examines the circuit with two different types of power switches and compares three of each type with different parameters.

In the resonant inverter the main losses are in the transistors of the bridge inverter.

The efficiency of the transistor resonant inverter is in the range from 0.90 to 0.93. In the double comparison with respect to transistors, the highest efficiency is obtained with the use of MOSFET-SiC, the difference with other types is up to about 5%.

It is observed that the graphs of the efficiency factors are compensated for the rectifier-inverter and the resulting curve for each combination is almost linear. The highest efficiency is obtained with diodes and MOSFET-SiC transistor with very good parameters and is 5% higher than the first.

1. Due to the different characteristics of the variation of the efficiency of the rectifier and the inverter, the total efficiency is weakly dependent on the change in current.

2. Thanks to the selected transformerless power scheme, the total efficiency is about 0.9. This shows good performance of the induction fluid heating system using the combined load.

P14. Mareva D. ” Practical orientation of the curriculum, improving student achievement ”- Национална научно-практическа конференция „Новите идеи в образованието - инвестиция в бъдещето”, (28-29 ноември 2014г.), БСУ, Бургас, стр.204-211, Европейски социален фонд, Проект BG 051 PO 001-3.1.07-0003

The main task of the course "Practical training" is the additional knowledge of students related to the practical application of electronic circuits used in many real operating devices. Study of widely popular schemes performing certain functions. There are several possible designs that are comparable to solve the same problem. In addition, familiarizing with the schemes, this material is aimed at automated design of electronic devices, printed circuit boards and software simulation by "Altium Designer" and "ORCAD 16.5". Students acquire knowledge of methods for production and realization of printed circuit boards, soldering of elements for small circuits, measurement and testing. Each topic ends with solving a practical example. From the analysis made so far, the following more important conclusions can be drawn:

1. Preliminary preparation of students is a key factor for success.

2. Different approaches to students provoke a desire to achieve high results.

3. Paying personal attention to each student, especially in more advanced or more demotivated students.

4. Different and interesting way of presenting the taught material and working with smaller groups for greater effect of learning.

5. The modern teaching process is a combination of modern theoretical knowledge, continuous updating and connecting them with practical realizations.

P15. Mareva D, Dimitar YUDOV and Emil MAREV "Electronic transformer for a small photovoltaic plant", SIELA 28-30 May 2012, XVII-th International Symposium on Electrical Apparatus and Technologies,Bourgas, Bulgaria, volume 1, pp.210-217,ISSN:1314-6297

The article presents an autonomous renewable energy system for the supply of home appliances. The system directly supplies the inverter device with the converted solar energy, thus passing the required 50 Hz DC-AC converter for energy injection into the electrical network. The approach discussed is applicable to other home systems. The realized DC-AC converter works with increased frequency and combines the requirements of both power supply RES. A significant share of electricity consumption falls on the service sector (households, hotels and others).

A characteristic feature of them is peak consumption during the different seasons of the year and the hours of the day. This fact raises certain issues that are significant for these consumers and for the electricity grid. This leads to the conclusion that these consumers need to reduce their dependence on the centralized power supplier.

The solution to the problem is to use small well-designed, local power plants, such as photovoltaic power plants. Apart from external factors such as the brightness and the quality of the photovoltaic itself, the efficiency of such a plant largely depends on two electronic factors:

- the type of galvanic isolation of photovoltaics from the network;
- the efficiency of the power electronic converters. In case of a requirement for galvanic separation of the photovoltaic system from the power supply network, it is expedient to use an electronic RF transformer.

With proper regulation, only the unused electricity in the household is injected into the network. In case of permissible changes of the control parameters (δ) stabilization of the supply voltage of inv.2 is obtained, which is a guarantee for good coordination of the parameters of inv.2 with the parameters of the supply network.

The analysis of switching losses proves their reduction compared to a circuit implemented with IGBT transistors.

P16. Юдов Д., Димитров Ат., Тошков Г., Mareva D., " Inverter welding current source with two resonant frequencies "- ., Научна конференция с международно участие "Присъединяването на България към Европейския съюз-предизвикателства, проблеми, перспективи" , (9÷11 юни), том III, БСУ-2006г., стр.271-278, ISBN -10: 954-9370-44-5, ISBN -13: 978-954-9370-44-7

This article presents an opportunity to implement an independent welding inverter with two resonant frequencies. The use of this type of inverter supports to eliminate high electrical loads on semiconductor power switches. A method for calculating the circuit elements is

derived. The conclusions are confirmed by PSpice analyzes.

When we consider an inverter welding source, the problems become even more severe because the welding sources work in all possible modes of operation - idling, welding and short circuit. Dynamic welding processes are associated with frequent transitions from idle to short circuit and vice versa.

This leads to large dynamic loads on the elements of the circuit and requires some protection. The requirements for the possibility to change the welding current are significant.

The purpose of this article is to show the choice of configuration of an autonomous inverter for welding and its design, which schematically removes the large electrical loads of the semiconductor power switches.

The mode of operation of the parallel capacitor CP with the oscillating capacitor CK significantly reduces the dynamic loads in the circuit elements.

In idle mode, the inverter operates at minimum load thanks to the parallel capacitor, which produces a natural resonant frequency several times higher than the resonant frequency in operating mode.

The adjustment of the welding current and voltage must be done by changing the quality factor Q within small limits.

The applied methodology measures the values of the resonant components precisely enough.

P17. Юдов Д., Тодоринов Г., Mareva D., " Inverter current source with pulse-arc welding " -, Научна конференция с международно участие "Присъединяването на България към Европейския съюз-предизвикателства, проблеми, перспективи", (9÷11 юни) , том III, БСУ-2006г., стр.279-285, ISBN -10: 954-9370-44-5, ISBN -13: 978-954-9370-44-7

This article presents the concept and analysis of a schematically realized autonomous inverter power supply for pulse induction arc welding. After an analysis of the different modes, a study on optimal and tight drive is presented.

In conventional welding current sources, pulse-arc welding schemes are known , in which current pulses of a certain shape, size, power and frequency are superimposed on the main welding current by an additional current source.

The purpose of this article is to show a schematic implementation and study of an autonomous inverter current source for pulsed arc welding.

It can be seen that when the welding current decreases, the values of the pulses automatically decrease. Welding with different electrodes, respectively with different welding current is obtained by adjusting the frequency of the control device.

1. Due to the large difference in the maximum and average value of the voltage after the output rectifier, pulse-arc welding is realized without an additional current source.

2. The energy characteristics of the pulse are determined by the value of the pulse capacitor and the magnitude of the welding current.

3. The pulse tracking interval is determined by the control device according to the type of welded material.

P18. Ангелов П., Mareva D. " Provoking independence in the practical work of the student ", Научна конференция на тема: "Съвременни технологии 06"-27÷28 април, Дряново 2006г, стр.111-115, ISBN 954-90611-9-1

Provoking independence in working with students is often accompanied by preliminary

ambition. The article addresses the issue of provoking precisely this type of ambition related to the study material. The presentation of the material to the audience by students sets high preliminary ambitions related to the very good preparation of the teacher. This, of course, is just one of the many factors that can provoke increased attention; another important element in the work is the attention we must pay to everyone. Most often this attention is paid to seminars and laboratory exercises.

From the analysis made so far, the following important conclusions can be pointed out:

1. Preliminary ambition as a major factor in decision.

2. Approaches to methods and ways to provoke ambition, especially for students who have achieved not very high results.

3. Separation of the necessary special and different way of presentation.

4. Provoking interest on the part of the lead teacher - respectively working with smaller groups in order to have a greater learning effect.

5. Synchrony between the knowledge transferred in theoretical aspect with those applied in practice.

6. The results shown by the student are a fact of his current knowledge and not of what he is able to learn or apply in practice.

P19. Тошков А., Mareva D., Марев Е. " Optical networks with subscriber access development concepts "- Годишник том XIII -БСУ, Бургас 2005г, стр.167÷174, ISSN:1311-221-X

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P20. Юдов Д., Mareva D., Димитров Ат. " Investigation of electronic starting-regulating equipment for fluorescent lamps "- Юбилейна научна конференция "60 години Русенски университет "Ангел Кънчев" -2005г.,(10÷12 ноември), Том 44, серия 3.1, стр.167÷171, ISSN 1311-3321

This article draws attention to the half-bridge inverter designed to power a fluorescent lamp. Dependencies have been developed for calculating the values of the reactive elements

of the circuit. The results of the simulation for the instantaneous values of charging of circuit elements and a fluorescent lamp in initial and operating mode are obtained. They determine the regulating characteristic of the circuit.

Many electronic ballast circuits are known, most of which are based on a half-bridge transistor inverter that acts as a voltage inverter or resonant inverter.

The aim of the present development is to analyze and study a suitable mode of operation of a half-bridge transistor inverter supplying fluorescent lamps.

From the performed simulation and experimental researches it is offered:

1. The mode of operation of the ballast at start-up mode in up resonant frequency and in operating mode in sub resonant frequency is suitable.

2. By controlling the duty cycle, the desired values of the voltage in the starting mode and stabilization of the operating current through the lamp can be obtained by changing the supply voltage and the duty cycle.

3. Possibility to obtain different values of voltage in start-up mode and stabilization of the operating current in case of change of the supply voltage are obtained at different values of the coefficient δ.

P21. Юдов Д., Mareva D., Марев Е. " Increasing bipolar current source "-"Съвременни технологии -'03, БСУ Бургас 2003г.(16÷17 октомври), стр.145÷153 ISBN 954-90611-9-1

The article describes a schematic diagram of a bipolar converter up for the purposes of car audio systems. The two-polar power supply is the basis of inverting and non-inverting inverters.

The control characteristics (control specifications) were achieved with the help of PSPICE models, including loss optimization, balancing of two converters to ensure equal output voltages of the two converters at different loads.

To improve the quality of sound in cars, it is necessary to increase the output power of radios. At increased output power it is more expedient to use power supply sources with voltage more than 12V, which leads to a reduction of the current in the final transistors, respectively a reduction of the losses in them.

For this purpose, a number of authors use a two-stage step-up transformer converter.

The aim of the present study is to synthesize and analyze an increasing transformer-free bipolar current source.

The following conclusions can be drawn from these simulation studies:

1. At the selected values of the circuit elements the output parameters have very good convergence.

2. Both converters have a falling external characteristic, which is normal for the circuits used.

3. The investigated range for variation of the output voltage from the load at different values of the filling factor δ shows the coverage of the requirements for stable output voltage, by using voltage feedback.

4. With the Hammer converter, the output voltage falls below the permissible value when the circuit is overloaded. This is not observed with the previous converter remaining stable under overload.

Р22. Юдов Д., Mareva D., Марев Е. "Two stage converter", Electronics ET'2001 Sozopol, 26- 28 September 2001, Book3 , стр.148-152, ISBN 954-9518-15-9

This article presents a 2-stage DC / DC converter. A DC / DC converter for zero voltage switching with D-C quenching circuit is proposed. The analysis of the total losses of the switches based on PSPICE simulations is presented. The dependence of the total losses of the switches is analyzed, depending on the parameters of the converter. High efficiency ZVS Boost DC / DC converters are applicable in UPS systems. The topology is suitable for an interlaced converter.

A problem with transistor converters is the switching losses of power semiconductor devices, which creates problems in the selection of the transistor and the removal of heat from the radiators. Zero voltage switching (ZVS) and zero current switching (ZCS) are used to reduce these losses.

The purpose of this study is:

- Development of a two-stage converter for the needs of BTC from 60V to 310V DC voltage and power around 400÷600W.
- Study of the developed converter in case of change of the supply voltage and the load within certain limits.
-Study of the switching losses on the active elements when changing the mode of operation of the converter.

1. From the performed researches it can be concluded that the step-up converter with the shown parameters can be used as a DC-DC power supply unit in the BTC system.
2. The implementation of a soft switching mode significantly simplifies the operating modes of the transistors.
3. The two-stroke converter when supplying responsible consumers allows higher reliability of the power supply at lower loads of the individual elements.

Р23. Юдов Д., Mareva D., Марев Е. " Development and application of modern switching power supplies " - Юбилейна научна конференция с международно участие "Университетът през третото хилядолетие"- том I- БСУ, Бургас 2001г., стр.117-123, ISSN:1311-221-X

The present work shows the classification of the main transistor converters used in the circuits for switching power supplies and their application. The process of soft current switching (ZCS) and voltage (ZVS) is considered.

Recommendations have been made for the further use of transistor converters in switching power supplies.

Increasing the operating frequency allows you to reduce the size of the passive elements and therefore reduce the volume, weight and cost of the device.

In recent years, significant progress has been made in the development of semiconductor power elements. Not only new generations of power semiconductor devices are appearing, but also new types of integrated modules. Power switches with built-in drivers and protections, several switches in one housing, as well as whole systems of power converter with PWM control and drivers realized as a hybrid integrated circuit have appeared on the market.

The following conclusions can be drawn from the above:

1). The great variety of power semiconductor elements and their use in passive LC groups has allowed the creation of a large number of circuit variants of pulse converters of electric energy.

2). The different circuit variants of the pulse converters have advantages at certain values of the load and its nature.

3). Single-stroke converters are used in switching power supplies for low power (up to 1000W).

4). The use of two-stroke converters is suitable for medium power. Multi-link converters are used at medium and high power when powering devices with increased requirements.

5). The use of soft current and voltage switching circuits is required for medium and high power transistor converters.

6). The further development of switching power supplies is aimed at improving control circuits in order to improve their energy performance, as well as obtaining electromagnetic compatibility in the operation of converters in the power supply network.