

Ternopil Iyan Pul'uj National Technical University

ВИЩА ТЕХНІЧНА ОСВІТА ГАРАНТ ВАШОГО УСПІХУ І ДОСТАТКУ

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UKRAINE

Design Methods of Switch Mode Power Supplies

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Criteria for designing of power supplies

ensure of functional parameters at activity of the disturbing factor efficiency reliability mass and dimensions > cost Specific requirement are following: high dynamic characteristics at high quality of output voltagés 100% change of a load current Iow level electromagnetic interference (EMI) other

Design of Switch Mode Power Supplies on base of High Frequency Magnetic Amplifier

25 years expirience

SMPS designing for different assignments – space, radar, medicine, information technology, transport systems, lighting systems, welding, communication, nuclear power station, etc.



Comparative analysis of transistor and magnetic switches

- The advantages of the magnetic switch in comparison with transistor switch are essential:
- is an AC voltage switch
- not critical to the form of input voltage
- gain on a current up to 1000
- simplicity of the control circuit (1-2 transistors in a linear mode)
- does not create electromagnetic interferences
- is by the filter of input interferences (both in non-saturated, and in a saturated condition)
 - high efficiency (99 %), the losses do not depend on load current
 high level of radiation stability and mechanical stability
 - does not require protection (itself serves a protection device of highfrequency transistor inverter)
- multifunctionality: the power amplifier, power switching device, pulsewidth modulator, executes functions of the integrator, comparator, protection device

Comparative analysis of power supply on MS with transistor analogs

Advantages SMPS on magnetic switches in comparison with traditional transistor power supplies:

- capability of designing of multichannel SMPS with equivalent and independent output channels with 100 % range of change of the load current
- are suppose a broad range of change of input voltage
- high level of specific power
- high quality of output voltages (the high-frequency peaks and low-frequency component are absent)
- Iow level of EMI
- high level of dynamic parameters
- high efficiency
- in 2-3 times the cost price is lower
- high level of radiation stability and mechanical stability
- above reliability for the account as physical nature of MK, so and of essential simplification of circuitry
- high level of unification possibility of using of one standard size of MS and same circuitry solutions for designing of SMPS in the broad range of output parameters

Main technical data of the multichannel switch mode power supplies:

Range of the input voltage change to ± 30% Efficiency 0.80 - 0. Output voltage levels 5 - 200∨ Pulse output voltage 10 - 50 r (low-frequency reply and high voltage spike are absent) Common non-stability to 1% **Current load levels** to 100A Range of the load current change 100% Possibility of the current stabilization Specific power on the home hardware 100 - 50 50 - 500 Output power multi-output SPS 1-10 or I Number of output regulated channels Output power of the channel 25 - 500 50 - 100 Frequency **-60** -+80 Temperature range Electro-magnetic compatibility and electro-safety in requirement accordance with base international standards of the computer and medical equipment

Structure of the switch mode power supply on magnetic switces with of the high level load current (5 V, 200 A)



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Multiway Switch Mode Power Supply for Radio Devices



> input voltage > output power > number output channels common nonstability > ripple of output voltages

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 $220 \pm$

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Power System and Control of Apparatus of "Artificial Kidney"

Block- scheme of the apparatus «the artificial kidney»
 (1 – dialyser, 2 – electrochemical regenerator, 3 – block of padding clearing, 4 – pump, 5 – power suply, 6 – control system, 7 - sensor unit of concentration, 8 – heat exchanger, 9 - sensor unit of temperature)

> input voltage > output power > number output channels > input current of control; Common nonstability

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Ternopol State Ivan Pul'uj Technical University

- input AC voltage
- input voltage range
- output channels

- range of the load current change
- efficiency
- ripple of output voltages
- common nonstability
- working frequency
- temperature range
- size

Switch Mode Power Supply for Radiostations of the Railway Transport

> output power > output voltage > load current 155...265V AC, 1 > input voltage > load current range \succ efficiency > working frequency > output voltage ripple common nonstability - 40

Power Supply of Brake Devices of the Electric Drive of Antenna

>

> output power

> max output power

 \succ number output channels

output voltage

load current

common nonstability

ripple of output voltages

Power supply for car radio scaner

- input voltage	$12V \pm 20\%$
- output power	100 W
- output voltage	24 V
- load current	04 A
- efficiency	75 %

- working frequency

50 кНz

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Power supply for IT

- input voltage
- output power
- output voltage
- load current
- efficiency
- working frequency
- temperature range
- dimension

220V ±20%, 50 Hz 240 W 24 V 0...10 A 88-92 % 50 KHz -10...+50 ° C 120x200x50 mm

Power supply with high level load current

- input voltage
- output power
- output voltage
- load current
- efficiency
- working frequency
- температурний діапазон
- габарити

135...270В, 50 Гц. 250 Вт 5 В 0...50 А 82 % 50 кГц - 40... +50 °С

100х220х60 мм

Power supply 24V, 10A

The load characteristics of the experimental MS power supply

Load current, A	0			4	,8		3	Input AC voltage,
	* **	*	**	*	** '	*/	**	
Output DC voltage, V	24,10	24,07	24,03	24,08	/24,03	24,09	24,01	100
	24,09	24,07	24,03	24,08	24,03	24,09	24,01	110
	24,09	24,07	24,03	24,08	24,02	24,09	24,01	120

Electromagnetic interferences for different power supplies (output power 240W) (analog PS – left, our PS design on magnetic switches – right)

EUT: DC/DC Converter Work Order: Serial Number: Prototype Date: 05/1 /00/2 Customer: Temperature: 24.4 Attendees: none Humidity: 41% Project: None Power: [120VAC/60Hz Tested by: Power: [120VAC/60Hz FCS 15/PCIFICATIONS Test Method	
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66.356	47.9	21.4	1.0	13.1	0.3	0.0	V		-10.5	29.5	40.0	-10.
51.198	42.1	21.3	1.0	14.8	0.3	0.0	H		-10.5	25.4	40.0	-14.
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Block Diagram of the proposed ac-dc converter

A basic push-pull MagAmp regulator circuit

Experimental waveforms of line voltage and current under full load (Pout=240W) as measured for: 230VAC, (b) 115VAC, (c) 90VAC line voltages. Ch1: Line voltage (100V/Div); Ch2: Line current (1.33Amp/Div); Horizontal scale 5mSec.

Power Factor as measured at 230VAC, 115VAC, 90VAC line voltages.

Converter's efficiency as measured for 230VAC, 115VAC, 90VAC line voltages.

THANKS

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PORTE DESCRIPTION OF