Problems of Power Supplies

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Abstract— This article will cover a variety of network power sources (micro-power, medium-power, high-power). The first problem that both novice and experienced radio Amateurs face when designing any devices is the problem of power supply. When selecting and developing a power source (hereinafter referred to as SP), a number of factors must be taken into account, determined by the operating conditions, load properties, safety requirements, etc.

Keywords— Electronic Equipment, High-Frequency Interference, Galvanic Connection.

I. INTRODUCTION

First of all, of course, you should pay attention to the compliance of the electrical parameters of the IP with the requirements of the powered device, namely:

• Supply voltage;
• Current consumption;
• Required level of power supply voltage stabilization;
• Acceptable level of supply voltage ripple.

The characteristics of individual entrepreneurs are also important, affecting its performance:

• Availability of security systems;
• Weight and dimensions.

As an integral part of electronic equipment, means of secondary power must meet certain requirements, which are defined as requirements to the equipment in General and the conditions imposed on the power supplies and their work within this equipment. Any of the IP parameters that go beyond the limits of acceptable requirements creates dissonance in the operation of the device. Therefore, before you start assembling the IP to the intended design, carefully analyze all available options and choose the IP that will best meet all your requirements and capabilities.

There are four main types of network power supplies:

* Transformer-free, with a quenching resistor or capacitor.
* Linear, made according to the classical scheme: step-down transformer-rectifier-filter-stabilizer.
* Secondary pulse: step-down transformer-filter-high-frequency Converter 20-400 kHz.
* Pulse high-voltage high-frequency: filter-rectifier ~220 V-pulse high-frequency Converter 20-400kHz. Linear power supplies are extremely simple and reliable, with no high-frequency interference. The high degree of availability of components and ease of manufacture makes them the most attractive to repeat novice radio designers. In addition, in some cases, a purely economic calculation is also important — the use of linear IP is clearly justified in devices that consume up to 500 mA, which require fairly small IP.

II. MAIN PART

These devices include:

• Battery chargers;
• Power supplies for radios, Aons, alarm systems, etc.

It should be noted that some designs that do not require galvanic isolation from the industrial network can be fed through a quenching capacitor or resistor, while the current consumption can reach hundreds of mA.

Micro-power IP with galvanic isolation from the network ~220 V can be performed using optocouplers, enabling them in series to increase the output voltage (Fig. 3.2-1.). Energy transfer is carried out by means of a unidirectional light flux inside the optocoupler (the optocoupler contains light-emitting and absorbing elements), so there is no galvanic connection with the network.

On one optocoupler, 0.5-0.7 V is allocated for AOD101, AOD302 and 4 V-for AOT102, AOT110 (at a current of 0.2 mA). To ensure the required voltage and current values, optocouplers are switched on in series or in parallel. As a
buffer accumulating element, you can use an ionistor, battery, or a capacity of 100-1000 UF. LEDs are powered through a capacity of no more than 0.2 UF to avoid destruction. It should be remembered that the efficiency of optocouplers decreases over time (by about 25% over 15,000 hours of operation).

![Figure-1. Battery](image1)

### III. MATERIAL METHODS

In micro-power power sources with a galvanic connection to the industrial network, so-called separation capacitors are usually used, which are nothing more than shunt resistances that are included in series in the power supply chain. It is known that a capacitor installed in an alternating current circuit has a resistance that depends on the frequency and is called reactive. The capacity of the separation capacitor (if used in an industrial network ~220 V, 50 Hz) can be calculated using the following formula:

\[
C = \frac{3200 \cdot I}{\sqrt{U_0^2 - U^2}}
\]

![Figure-2. Network formula](image2)

Device is suitable for charging batteries with a current of no more than 100 mA at a charge voltage of no more than 15V. The necessary value of the charge voltage is set using the R2 tuning resistor. R1 acts as a current limiter at the beginning of the charge, and the voltage generated on it is applied to the led. By the intensity of the led light, you can judge how low the battery is.

![Figure-3. Device is suitable](image3)

### IV. CONCLUSION

When using this power source (and any other IP without galvanic isolation from the network), you must remember about safety measures. The device and the battery being charged are always under the potential of the industrial network. In some cases, such restrictions make it impossible to operate the devices normally, so it is necessary to provide a galvanic isolation of the IP from the network.

A low-power power source with a separation capacitor, but with a galvanic isolation from the industrial network, can be made on the basis of a transient transformer or a magnetic starter relay, and their operating voltage can be lower than 220. Currently, traditional linear power supplies are increasingly being replaced by pulse power supplies. However, despite this, they continue to be a very convenient and practical solution in most cases of Amateur radio design (sometimes in industrial devices). There are several reasons for this: first, linear power supplies are structurally quite simple and easy to configure, second, they do not require the use of expensive high-voltage components, and finally, they are much more reliable than pulse IP.

### REFERENCES


