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DEVELOPMENT OF TECHNOLOGIES FOR THE ENRICHMENT OF LITHIUM ORE RAW MATERIALS FOR THE PRODUCTION OF LI-ION ELECTRIC ACCUMULATORS AT THE DEPOSITS OF UKRAINE

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ASSESSMENT OF THE INFLUENCE OF NONLINEARITIES ON THE DISTORTION OF THE USEFUL SIGNAL

Distortions of a weak useful signal in its frequency band at the output of the amplifier under the action of a powerful interference at the input, which turns the amplifier into a non-linear mode, are due to the following non-linear effects [1]:

– amplitude-amplitude cross modulation (by transferring the amplitude modulation of interference to the signal envelope);

– amplitude-phase cross-modulation (by transferring the amplitude modulation of interference to the signal phase);

– by mutual modulation (falling of intermodulation components of the signal and interference, interference and noise, several interferences, etc. in the band of the field signal);

– inertia in relation to the envelope (changes in the envelope of a weak useful signal at the output of the amplifier will not be synchronous with rapid changes in the envelope of powerful interference at the input).

In addition, in a particular case, the useful signal can be strongly distorted or even practically suppressed by one of the interference harmonics when it enters the useful signal band. This will happen if the interference frequency is less than the frequency of the useful signal by an integer number of times [2].

If the useful signal is not suppressed by the interference harmonics, then the interference itself and its harmonics, as well as the harmonics of the useful signal and intermodulation components can be suppressed in the following high-frequency and low-frequency cascades of the receiver containing bandpass filters and low-pass filters following the low-noise amplifier (LSA).

At the same time, the LNA itself in a substantially non-linear mode is simultaneously a limiter of the interference power.

In order to estimate the degree of distortion of the useful signal caused by the nonlinear effects listed above, theoretical and experimental studies were conducted that allowed to determine the degree of manifestation of these nonlinear effects.

We consider the intermodulation components formed by a weak harmonic useful signal and a single powerful harmonic interference.

The order and amount of intermodulation components falling into the band of the useful signal will depend on the ratio of signal and interference frequencies.

As is known, the power of intermodulation components, as a rule, decreases with the growth of their order, therefore, the 3rd and 5th orders represent the greatest danger from the point of view of deterioration of the signal/interference ratio in the signal band.

To theoretically estimate the power of intermodulation components and the useful signal at the output of the amplifier, we use the inertialess model of the amplifier, the transient characteristic of which is given in the form of an error function/

In this expression, c = 0.5 sets the symmetrical levels of the output voltage limitation uout G = 10 (20 dB) is the gain of the amplifier in the linear section of the pass characteristic.

The choice of the error function as the pass characteristic of the amplifier is due to its great similarity with the pass characteristics of real amplifiers, and it is often used for similar purposes.

The values of the parameters c and G are chosen based on the similarity with similar parameters of the passing characteristics of modern integrated low-noise amplifiers, which have approximately the same levels of voltage limitation on the load of 50 Ohms and a gain factor in the linear mode of 10-25 dB.

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ОЦІНКА ВПЛИВУ НЕЛІНІЙНОСТЕЙ НА СПОТВОРЕННЯ КОРИСНОГО СИГНАЛУ

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