# GPRS SYSTEM FOR MONITORING OF BREAK - DOWN AND TRANSIENT PROCESSES AT CURRENT SOURCE PARALLEL INVERTERS

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*This article is dedicated to the realization of a GPRS system for monitoring of break-down and transient processes of a converter for induction heating. A structural scheme and an algorithm of work are represented and the influence of the system for control upon the security of work of the power electric device is summarized. The main parameters which the system can follow and which determine the arising of a break-down process are described. Due to this the main ways for reduction of the heating influence of the break-down current through the undamaged devices after a failure are defined. The suggested algorithm can be used for development of systems for control.*

**Keywords:** GPRS, Power converters, Power Semiconductor, Digital complex, break – down process.

The development and the popular introducing of power converter devices imposes the differentiation of a separate direction in this trend, predetermined by common break - down situations and connected with this economic sequences. The entering elements of a new generation allow work at high frequencies. The increase of working frequencies at the autonomic inverters reduces the size of the passive elements, and this reduces the volume, the weight and the price of a device. Also at great powers there is a need of connecting of several modules serial or parallel and this increases the difficulty of the converter and reduces its reliability. This leads to the necessity of an analyses of the three main regimes of work of the autonomic inverter (in particular the parallel inverter of current), which can be defined in this way:

1. A starting regime and the connected with it transient processes. This leads to one of the next two regimes after its finishing.
2. A normal working regime or a fixed regime with giving an account of the changes of the loads. Till the end of the working of the inverter it is possible to pass to the third main regime.
3. A break-down regime, which most often is accompanied with a flow of significant currents till the moment of their interruption from the systems for defense.

The missing unit in the analyses is the transition between these two regimes [1]. The interest toward this material is a result from the objective increase of the responsibility and multifunctionality of the Power Electronic Devices, in the conditions of their limited flawlessness. The imposed use of silicon devices in power converters predetermines their sensitiveness to overworking - short circuits (S.C.) and overvoltages [2], as well as the impossibility to restore them after a thermal or electric break [3].

In fig.1 there is shown the succession of a failure which is taken into account when programming the working algorithm of the system.

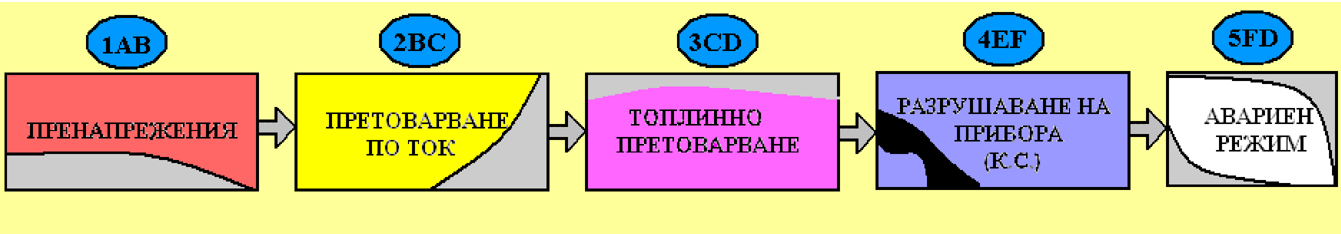


*Fig.1 A summarized algorithm of the break – down model.*

Another essential moment is the defining of the main " hot " points in the power scheme which would lead to a rise of regime 3. The occasions that are met most often are shown in fig. 2. The first one is a damage of a transistor (thyristor) or a diode in one of the arms of the bridge. The simultaneous conducting of devices from one and the same arm of the inverter is a second variant. It is more dangerous for the invertors which have no inductor in their entrance chain, because there is nothing to restrict the speed of increase of the current. The third and fourth variants are for cases when there are damages in the load chain of the invertors.

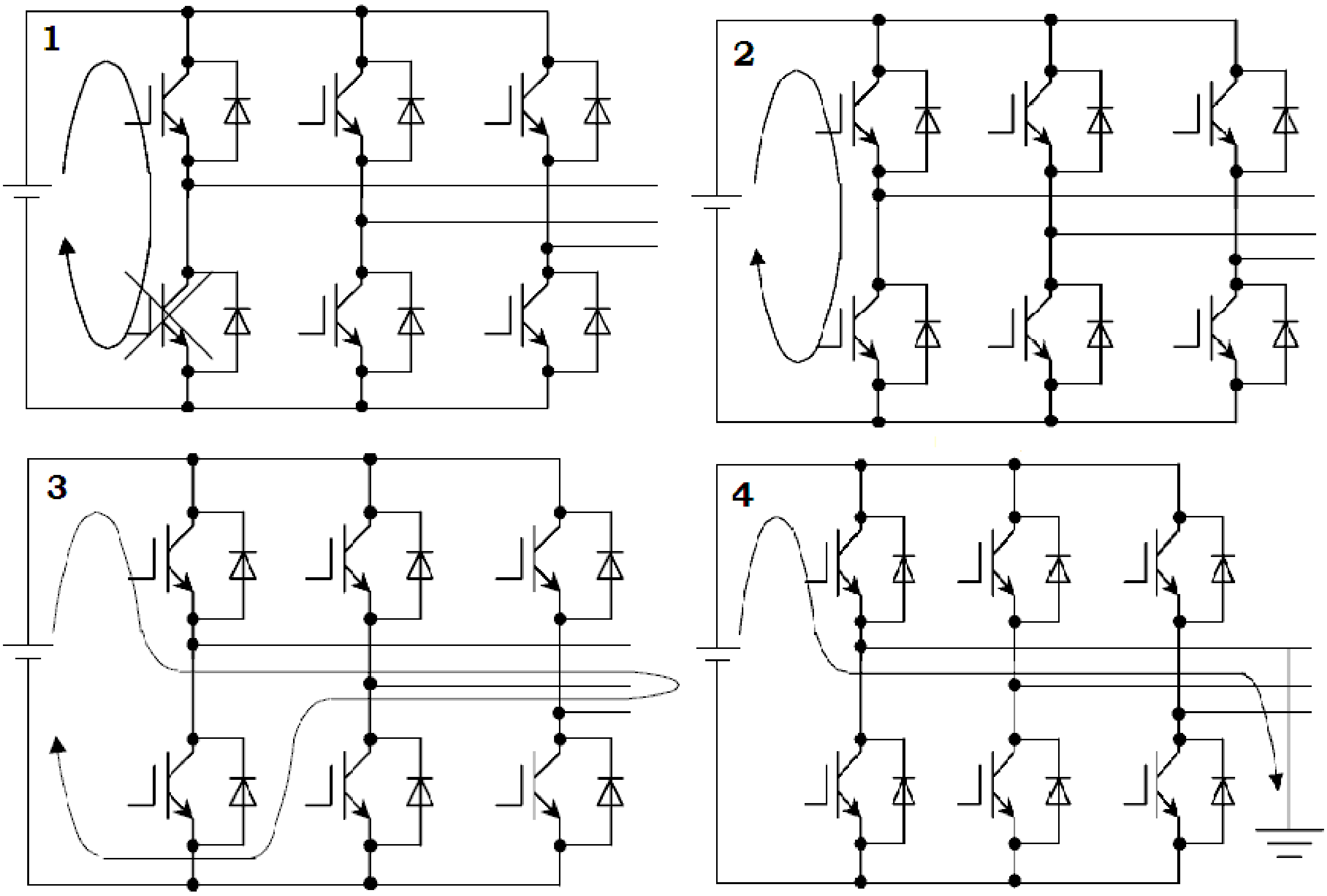


*Fig.2* Break – down currents.

By all means it is given an account the fact that in inverters the disruption of the normal work of the system of control leads to heavy break - down regimes, because it leads to simultaneous opening of devices of one and the same arm (short circuit of the power supply) or two adjacent devices (short circuit of load capacitor) [4]. Very often the requirements for reliability are satisfied by means of a great reducing of the loading of the devices, which by all means leads to an increase of the price and the size [5]. In other words, no matter their popular starting use nowadays their diagnostic insurance in the process of exploitation is at a low technical and technological level. This leads to the following unwanted and economically unprofitable results for the whole PED:

- Many of these devices are used under pressure of overpressure which leads to shortening of their working resource.
- During various repair and remedy work or exchange of power semiconductor elements there are no necessary optimal heat and exploitation regimes, which leads to a loss of working resources.
- Because of a lack of optimal technical means periodical checking of the technical data are note done even during service. This is a reason some devices to break down before reaching half of their guaranteed exploitation time date.
- Many electronic devices work with lower qualitative parameters because of the use of inaccurate and subjective methods for determination of the whole status, as well as because of the lack of criteria for estimation of their parameters.

Therefore on the basis of upper considerations a universal Digital - Parametric Measuring Complex (DPMC) [3] was developed, the need of which is unquestionable.

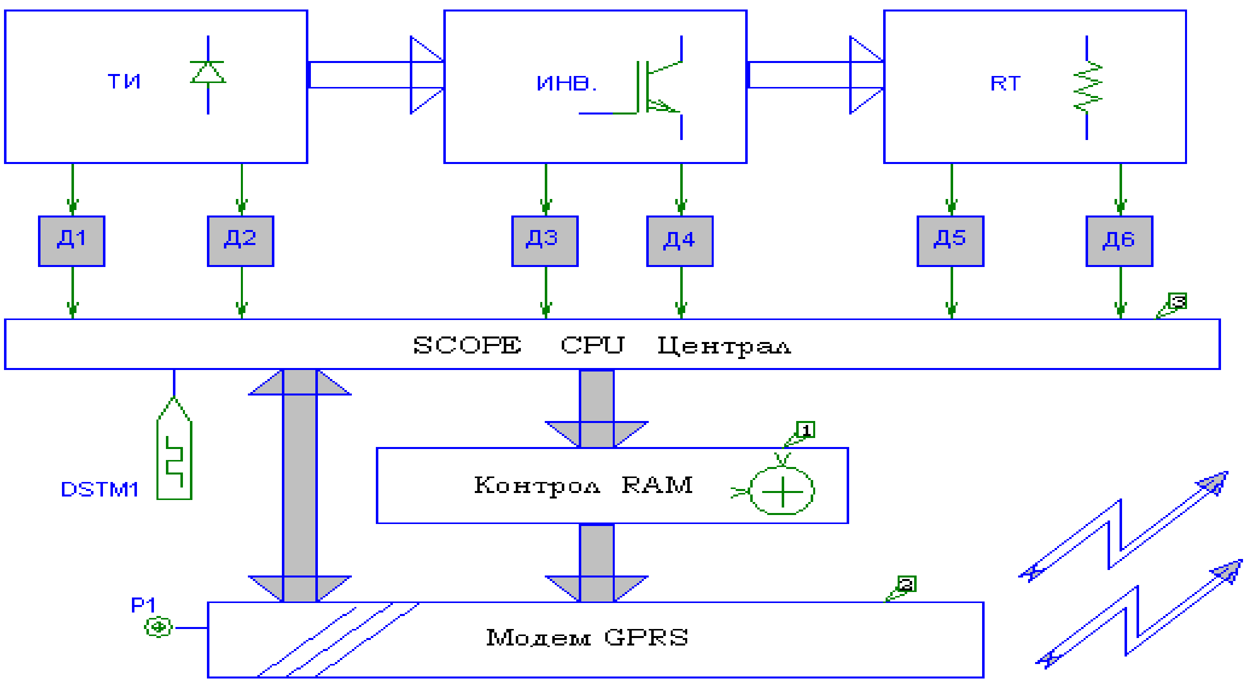


*Fig.3 Structural scheme of monitoring system.*

In fig.3 there is shown the structural scheme of the worked out system for monitoring. The information by the sensors Д1-Д6 is taken away from the three main junctions for the most common case in practice - Rectifier, Converter and Load. Therefore the received data is worked up from the microprocessor core and are retained. By the GPRS modem they are sent to the main computer for a further processing and visualization. The parameters that have to be supervised are: the three phase current on the input of the rectifier, the output voltage, the input current of the inverter, the input current of the load circle, the voltage upon the load and the phase offset between the current and the voltage of the load. These values give a full picture for the work of the device and each of them can indicate failure. In fig.4 there is shown the structure of one of the sensors, in which the measurement of the input current, the voltage and the power consumed by the inverter is integrated.

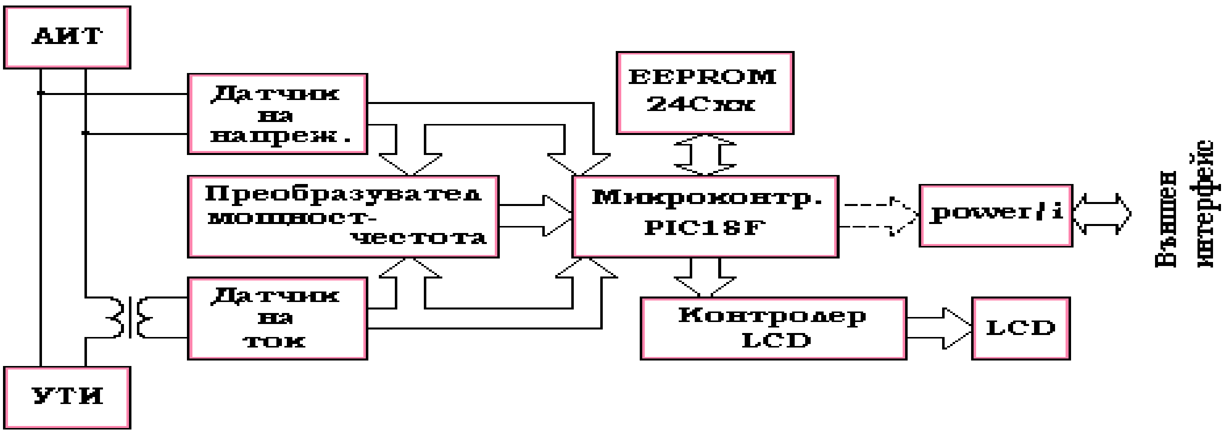


*Fig.4. Structural scheme of input sensor*

It is necessary to note the time of e conversion of the analog to digital converter and the minimal tact frequency of the microcontrollers. The blocks working parallel with the core are modeled as a separate group and thus they cover the requirement for a work in a real time [7]. The minimal input/output capacity of the module sensors can be calculated from five determining clusters:

(1) $$IM = \max_{1 \le i \le g}\left[\max_{1 \le j \le n(Oi)} n(I_{Oi,j} \cap I_i)\right]$$

(2) $$AM = \max_{1 \le i \le g}\left[\max_{1 \le j \le n(Oi)} n(A_{Oi,j} \cap A_i)\right]$$

(3) $$PM = \max_{1 \le i \le g}\left[\max_{1 \le j \le n(Oi)} n(P_{Oi,j})\right]$$

(4) $$QM = \max_{1 \le i \le g}\left[\max_{1 \le j \le n(Oi)} n(Q_{Oi,j} \cap Q_i)\right]$$

(5) $$CM = \max_{1 \le i \le g}\left[\max_{1 \le j \le n(Oi)} n(C_{Oi,j} \cap C_i)\right]$$

IM, AM, PM and CM are the multitude in each group ($1 \le i \le g$ ) of digital inputs, analog inputs, inputs of blocks, working in parallel, digital outputs and analog outputs. The possibility of logging on the system to the Global Net is shown in fig.5.

In this way the added options are a possibility to monitor converters and they can be represented to a wide range of users.

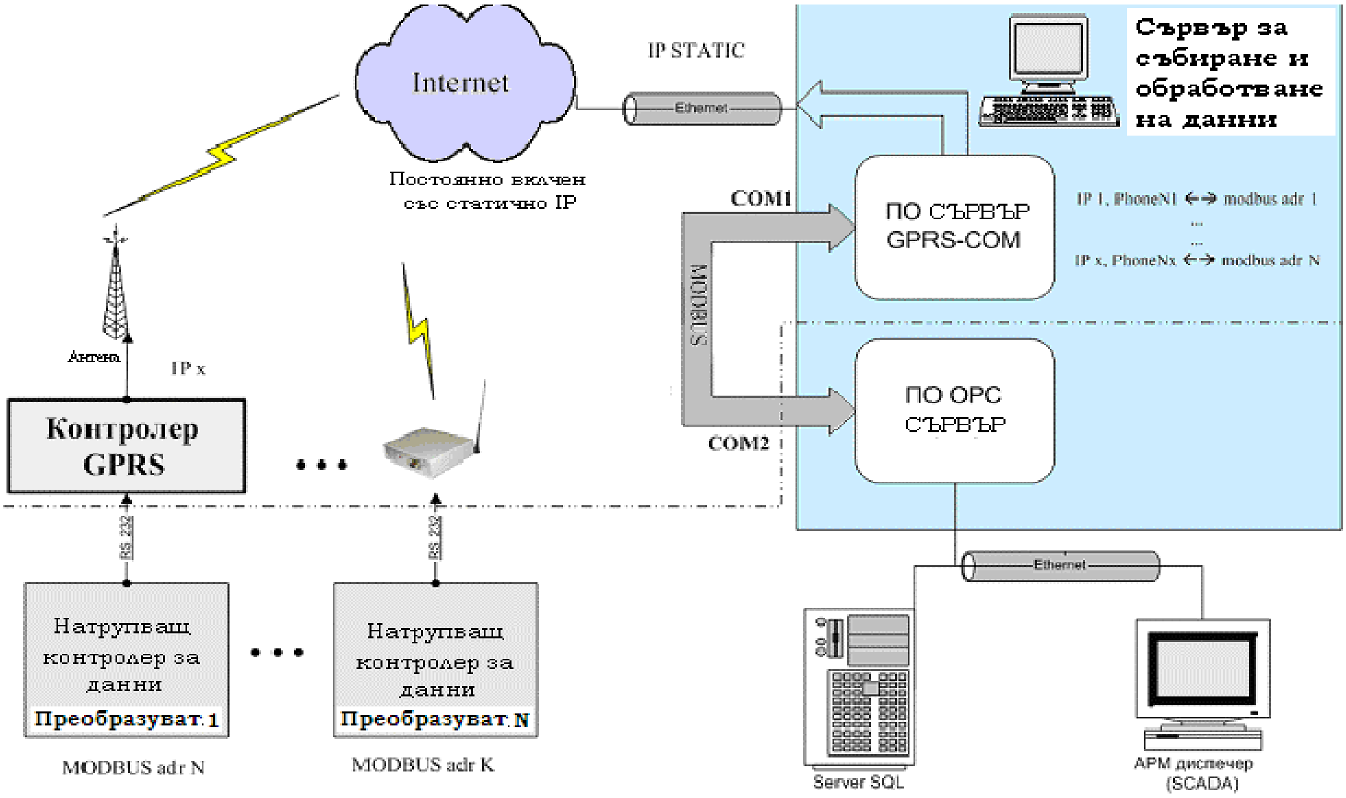


*Fig.5.Structure of virtual system*

A possibility the PED to be controlled remotely is provided and also the optimization of the working regimes of power semiconductor elements, as well as any break - down situations to be avoided.

The principle methods of approach for the realization of the system for monitoring are:

- The integration is done on a base of the existing scheme decision and the present system for operation (SO). The main communication is achieved by the interface

  Power/I, and the main parameters are analyzed depending on the type and application of PED.
- The integrated introducing of the possibilities of the complex together with the SO, right in the beginning of the process of initial designing of PED.

Having in mind the existing working converter devices with available resource, there is a great interest towards the first approach, which is laied on the base of the designed system. An analyses of the algorithms, whose use is expedient in the realization of the process of diagnostication is done. The summarized algorithm is a combination of particular algorithms. They include the process of gathering, converting, distributing, digital, arithmetic and logical processing of the gathered information, as well as its presenting in the needed form and controlling of the work of all devices in the process of working out of the operations. The methods and rules for working up this type of information are really various and differ in quality and quantity from each other. As a result in practice are possible too many algorithms, which can give similar results with the use of different methods and at the same time they differ from each other by the quality of the done procedures, the time for their realization, the precision and therefore their effectiveness and expedience.

## CONCLUSION

The suggested system for monitoring offer a great range of possibilities for the realization of the principles for modeling of an optimal strategy for diagnostic insurance of a PED and long term models for optimization of the process of control and diagnostication. A great volume of statistic information for any break - down regimes is gathered, that can be used for analyses. From the present article we can make a conclusion that the control of the working process by the use of digital and parametric methods is grounded to begin together with the planning of PED.

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