MONITORING SYSTEM FOR TESTING TECHNICAL DRIVE DIAGNOSTIC

Andrzej Maciej Kobosko

Industrial Research Institute for Automation
& Measurements, PIAP, Poland,
02-486 Warszawa, Al. Jerozolimskie 202
Phone:(22) 8740-263, Fax(22)8740-220
e-mail: akobosko@sg.piap.waw.pl

Abstract - *The paper presents the computerised multichannel system for monitoring and testing the dynamic processes in electrical and hybrid drives. The system operates „on line" in very short response time on telemetric base. It provides the continuous measurements of the following parameters: rotary speeds, torques and electrical currents and tensions. The measurement date is stored in the computer so it allows further „off line" analysis and conversion.*

This way the galvanic connections are avoided between wires and transducers. The wireless connections provide wide frequency band, good accuracy, linearity and short response time.

The second part of this paper presents the influence of explosive atmosphere on monitoring sensors design at intrinsic safety technique. The design procedure of a monitoring system has also been shown on the base system fig1 and fig.2(for sensors).

Keywords: monitoring system for power drive, intrinsic safety sensors,

1. INTRODUCTION

The mechanical structure of hybrid drives is very sophisticated and complicated. The drives have to meet performance, environmental and many other requirements as well. This is only possible by applying the proper control system and proper adjusted control functions.
The control function x'(t) must take into consideration the input function u(t) and precisely defined state function x(t). This is the reason why precise, real-time monitoring of mechanical and electrical parameters in the hybrid drive is so significant.

$$\dot{x} - f\left(x(t), u(t)\right) = 0$$

The paper presents the laboratory stand used to test the hybrid drive. The stand is equipped with the high-end monitoring system that measures simultaneously mechanical parameters (torques and rotary speeds of planetary gear shafts) and electrical parameters (voltages and currents of Permanent Magnet synchronous motor, voltage, current and State of Charge – SOC of the battery). The electrical parameters are measured by transducers that take advantage of Hall's effect. The way on the galvanic connections are avoided between wires and transducers. The wireless connections provide wide frequency band, good accuracy, linearity and short response time. The mechanical parameters (torques and rotary speeds) are measured by telemetric system. The signals from rotating with shafts extensometers are amplified and transferred via magnetic field to remote, immovable detectors.

2. THE PRINCIPLES OF SHAPE ADAPTION

All the electrical and mechanical signals are transformed to the voltage signal of +/- 10 V form and collected by the data acquisition system. The acquisition system can collect simultaneously up to 16 signals with frequency up to 300 000 S/s (samples per second).

The methods described above provide very accurate measurement results and a low level of interferences in the full range of occurring frequencies. The monitoring system makes it possible to determine the real dynamic state of the drive quickly and then to determine the proper control functions.

ISBN 972-98115-4-7

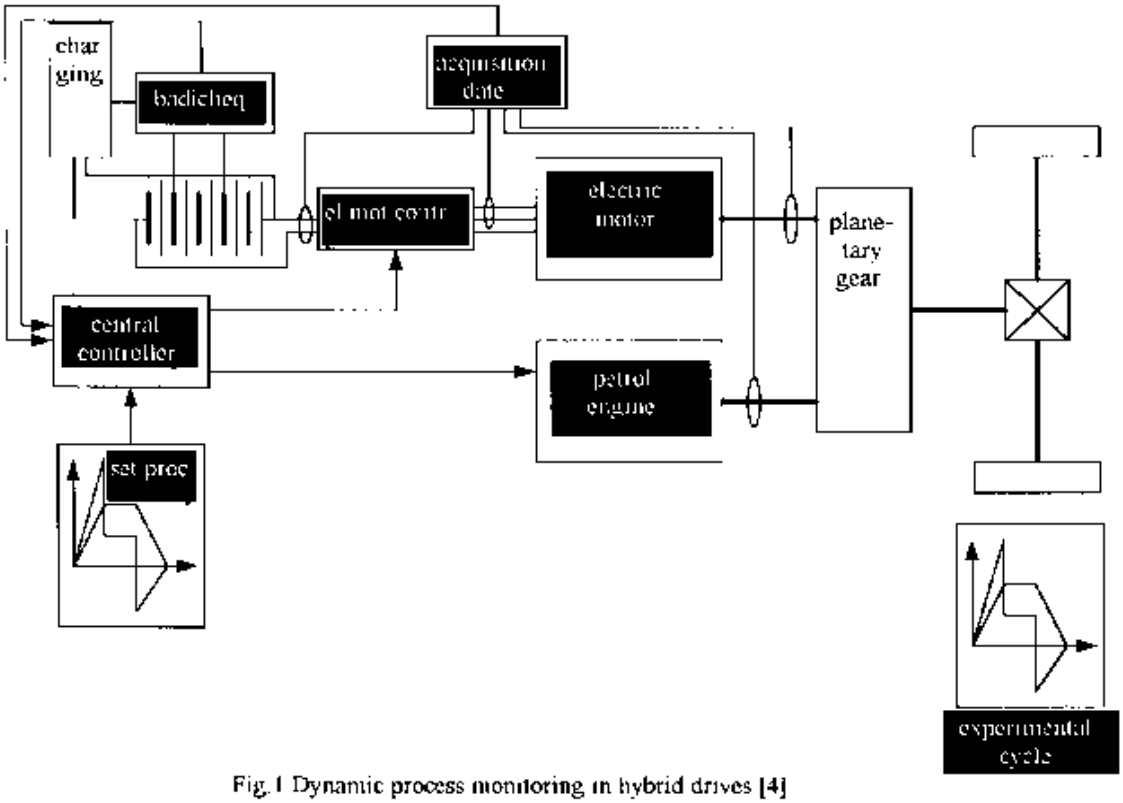

Fig.1 Dynamic process monitoring in hybrid drives [4]

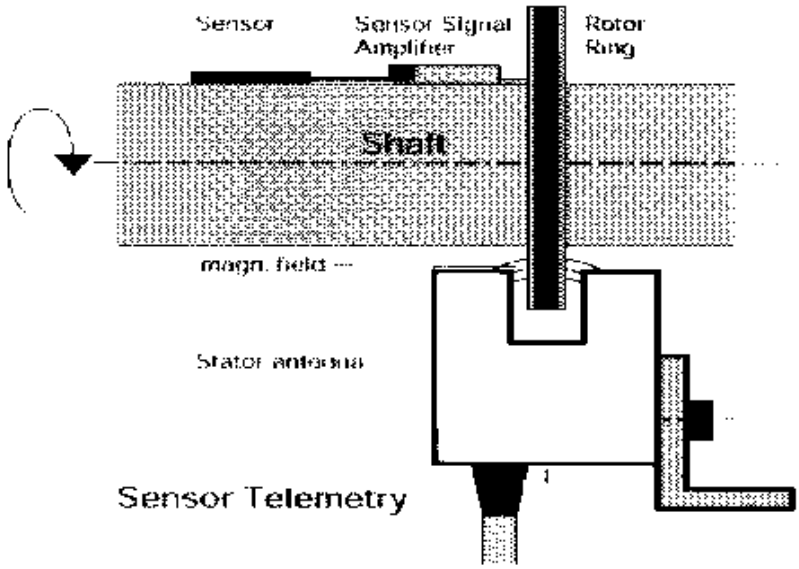

Fig.2 Sensors in laboratory stand [5]

In laboratory stand we use signal from sensors, fig.2 to monitoring system.

CHARACTERISTIC DATE

- for electric transducers
  current / tension

1. frequency band: 0 - 500 kHz,
2. accuracy: ± 0,1% at 25^0C,
3. linearity: ± 0,05 %.
4. response time: 0,4 μs.

- for electric transducers
  tension / tension

1. frequency band: up to few kHz,
2. accuracy: ± 1,0 % at 25^0C,
3. response time: 10 μs.

- for telemetric system

1. carrier frequency: 100 kHz,
2. linearity: < 0,05 %,
3. amplification from 100 up to 100 000.

The monitoring diagrames are to large for presenting in this paper. This diagram will be presented by the author, and copies will be obtained on request.

3. TERMAL PROCESSES MONITORING IN HAZARDOUS AREAS

Many parts of electrical and hybrid drives are working in hazardous area where hazardous mixture of gas and air being presented. The propability can be matched of equipment becoming dangerous. The hazardous area occurence of diesel (petrolum) engines, electrical motors of drives and other. For this area we must thermal process monitoring under abnormal conditions, fig. 3.

All equipment sensors, transducers, barriers and others working in hazardous area and be designed on to the general principles of intrinsic safety. This technique for ensuring that the electrical energy available in a circuit is too low to ignite the most easily ignitable mixture of gas and air. The design of the circuit and equipment is intended to ensure safety both in normal use and in all probable fault conditions.

Intrinsic safe circuit as a circuit which no spark occurs for exemple unload electrostatic energy or any thermal effect produced is not capable of causing ignition of a given explosive atmosphere. On fig.4 are presented electrical parameters of an intrinsically safe circuit. A new Directive of the European Parliament [7] containes more information about it.

4.ELECTRICAL CONNECTION SENSORS, TRANDUCERS AND COMPUTERS ELEMENTS IN MONITORING SYSTEM.

The progress of connection elements in monitoring system insearching for reducing numbers of wires and cables in electronic equipment.

In european countries CAN-Bus (Controller Area Network Bus) are standard. In industrial application in this system use 2-3 wires.

In USA, Dallas Semiconductor offeres system 1-Wire MicroLAN communicating digitally over twisted-pair cable with 1-Wire components. We tested monitoring system with temperature sensors for hazardous areas. System are more complicate. We use untypical barriers, computer system for hazardous are and so. This system is easy for application compair typical systems with tradicional ones of connection. For this system we use 1-Wire digital termometers (up to few thousand sensors) and MicroLAN interface.

REFERENCE

[1] Dźwiarek M., Kosztowski S., Miareczko B., Missala T., Modele oceny zgodności bezpieczeństwa wyrobów z dziedziny automatyki, robotyki oraz zintegrowanych systemów wytwarzania, *CIOP* 2000, p.123.

[2] Kobosko A., Systemy monitorowania w elewatorach zbożowych, *PIAP,Warszawa,2000*, p.144.

[3] Kobosko A., Monitoring systems for protection against dust explosions, *Proc. of IMEKO World Congress*, Vien 2000 p. 371(pp.6).

[4] Piórkowski P., Kobosko A., Systemy monitorowania procesów szybkozmiennych, *KN Automation, 2001*, *Warszawa,* pp.114-124.

[5] Szumanowski A., Piórkowski P. , Hajduga A., Nguyen K.V., „The Approach to Proper Control of Hybrid Drive", *EVS 17 Montreal*, Kanada 2000.

[6] Application Note AN9003: A user`s guide to intrinsic safety, *Measurement Technology Limited*, Great Britain, 1989.

[7] Directive 94/9/EC European Parliament of the council of 23 march 1994 ATEX OJ L100.

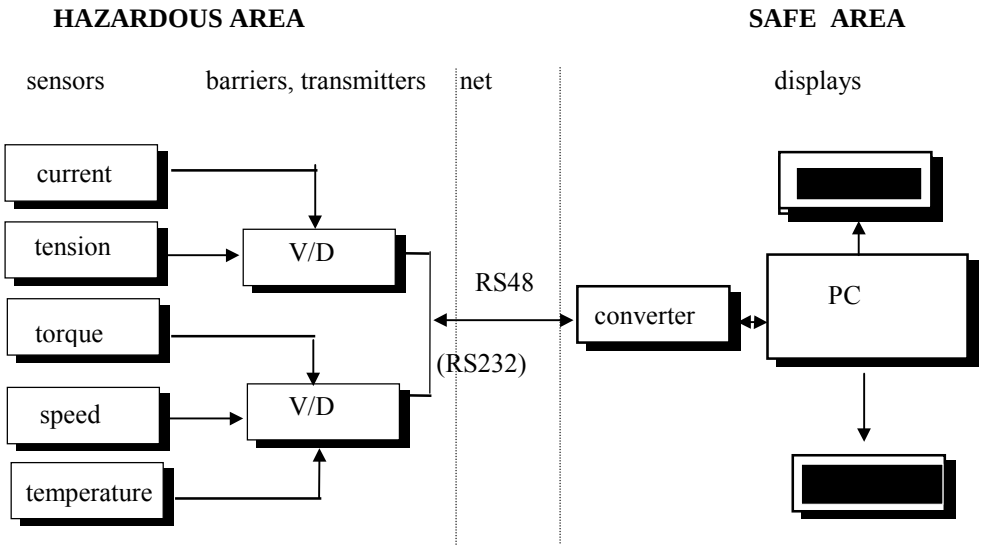

Fig. 3. Monitoring system for process variables in hazardous areas [2,3]

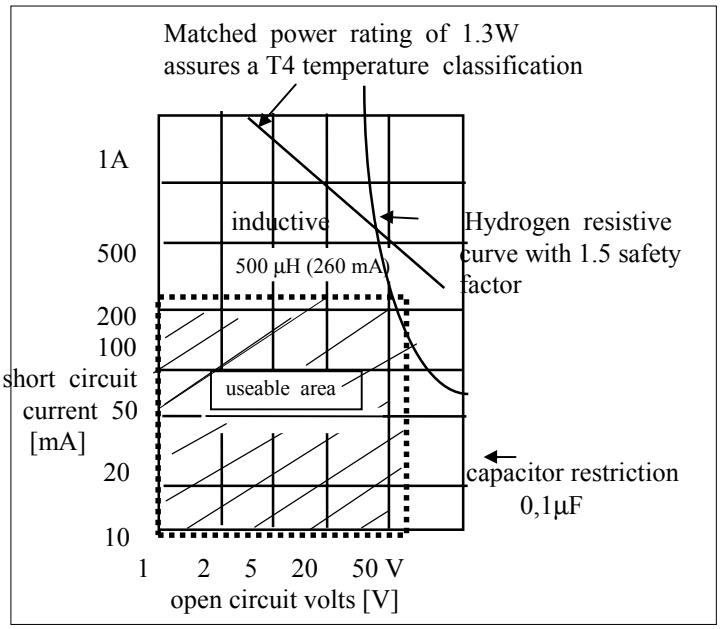

Fig.4. Current and voltage limitations of
an intrinsically safe circuit [6]