

The invention relates to a device for monitoring an electronic control device for a printing machine having modules connected by means of a bus system, at least one memory, at least one input and output unit, and
5 at least one display device.

The control of printing machines with the aid of digital control devices frequently also encompasses functions in which errors can result in considerable material damage, or even the endangerment of persons.
10 Very stringent demands are therefore also made on the reliability of individual system components, particularly in the case where control devices have complex structures.

A printing machine having a number of measuring devices, sensors generating electronic signals, electronically controllable actuators, batteries, and also at least one control and monitoring console for the monitoring, open-loop control and closed-loop control of the entire printing operation is described in EP-A-0 243 661.
15 The latter application relates to an overall central electronics unit which controls and monitors the entire processing of all the sensor signals as well as the entire coordination of the actuating signals by means of a data processing and control device.
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Errors can nevertheless occur within the control device, in the region of the sensors and actuators which connect the control device to the printing machine, and on the printing machine. Moreover, it is important to rectify errors occurring on printing machines as quickly
25 as possible and by the personnel available at the location of the printing machine.
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The object of the present invention is therefore to state a device and a method respectively for monitoring the electronic control device for a printing machine
35 which permits a reliable detection and indication of errors. In addition, if possible it should also be possible to detect errors even if a processor normally executing the monitoring fails. Finally, subsequent diagnostics is required for errors which occur only

sporadically, or for errors which result in the failure of the control device.

According to the invention, the object is achieved in that it [sic] has at least two modules, one module serving for the central control of the printing machine and another module serving to control the main drive, in that the modules have at least one processor in each case and a non-volatile memory in each case, in that the modules have at least one separate interface connected to a central display unit, and in that each module has a separate power supply unit. Furthermore, the object is achieved by the method according to the invention in that first of all a self-testing of the processors is carried out after switching on, in that after that a read/write memory serving for communication between the processors is successively tested by one of the processors in each case, and in that a testing of the processors among one another is carried out after the read/write memory has been tested.

To further increase reliability, two processors are provided for testing and monitoring which, in addition to the modules associated with them in each case, also test and monitor the respective other processor and means for communication between the processors.

Since control tasks are often divided between two processors in any case on printing machines, economic and reliable monitoring is possible due to the fact that two processors are provided for different control tasks in the control device, which processors furthermore test and monitor modules associated with them in each case and the respective other processor and means for communication between the processors.

With the diagnostics system according to the invention it is possible on the one hand to evaluate data which are present in any case during the operation of the printing machine, for example output signals of sensors such as speed sensors or paper sensors. Such data will be referred to as operating parameters in the text below. The diagnostics system according to the invention also

evaluates data generated in test programs, such as in programs known per se for testing memories or processors for example. It is also possible to include operating parameters in such tests, for example in the form of
5 nominal/actual comparisons or so-called plausibility checks. In the case of errors, the results of such tests - called test results in the text below - will be referred to hereafter as error messages.

In order to enable error messages to be indicated
10 reliably, at least one of the processors has an output for error messages that bypasses the bus system. It is advantageous here that each of the processors is arranged on a separate system card, and that the processors are connected independently of one another to at least one
15 display means in each case.

Other further developments of the invention relate to the storage of information important for repair and maintenance work. In this case, essentially non-volatile storage is provided in order to be able to
20 evaluate important data even after the printing machine or the control device has been switched off. For this, depending on the embodiment of the invention, error messages, test results or operating parameters can be stored. The data can preferably be stored in such a way
25 that the respective newest data are located in a non-volatile memory.

Advantageous further developments and refinements of the invention stated in the main claim are possible by virtue of the measures stated in the subclaims.

30 An exemplary embodiment of the invention is described in greater detail in the description below and illustrated in the drawing with reference to several figures, in which:

Fig. 1 shows a block circuit diagram of a digital control device for a printing machine having a
35 diagnostics system according to the invention, and

Fig. 2 shows a flowchart of a program used in the exemplary embodiment.

Provided in the control device illustrated in Fig. 1 are two modules (computers) 1, 2, one of which is arranged on a system card in each case. The computer 1 serves for the central control of the printing machine, while the computer 2 essentially serves to control the main drive. Each computer 1, 2 has in a manner known per se a (micro)processor 3, 4 and further modules, such as main memory, program memory and internal bus system for example; explanation of these is however not necessary for understanding the present invention.

Apart from said modules, however, non-volatile memories 5, 6 are provided on the computer cards, which memories store test results, operating data and error messages required for a subsequent evaluation even after the control device is switched off or develops a defect. In the case of error messages which do not result in failure of the control device or of the affected computer, if required a plurality of error messages may be stored with other meaningful test results and operating parameters.

As a result of a non-volatile memory 5, 6 being provided in each of the computers 1, 2, error messages can be evaluated even if the corresponding card has been removed from the control device and is at the manufacturers or a maintenance provider for the purposes of repair for example.

The computers 1, 2 are connected to a system bus 7, which is furthermore connected to an input/output unit 8 and a communication memory 9. The communication memory 9 serves to exchange data between the computers 1, 2 in such a way that the respective receiving computer calls up from the communication memory 9 the data which the sending computer has previously written into it. Furthermore, it is also possible to store test results and error messages in the communication memory 9, which is then designed as a non-volatile memory. Said test results and error messages can then be read out by both computers 1, 2.

Sensors and actuators are connected to the

input/output unit 8 via inputs and outputs 10, as is described for example in Patent Application DE-A-3 642 500 of the applicant.

For indicating the data occurring during operation of the printing machine, a central display unit 11 is connected to the computer 1 via a serial interface 12. With the diagnostics system according to the invention, the interface 12 and the display unit 11 are additionally used for indicating error messages. Further display units 13, 14 are connected to the input/output unit 8 via serial interfaces 15, 16 and likewise serve to indicate error messages in addition to indicating operational data.

The computer 2 for controlling the main drive is connected to a control card 17 for the main drive, to which the motor 19 of the main drive is connected via a power stage 18. In addition, the control card 17 has a connection to the system bus 7 so that, for example, the computer 1 can interrogate the status of the power control card 17. A plurality of power supply units, of which only two power supply units are illustrated in Fig. 1 by way of example, are provided for supplying voltage to the digital control device. For safety reasons, it is provided that the computer 1 and the central display unit 11 are connected to a first power supply unit 20, and the computer 2, the input/output unit 8 and the further display units 13, 14 are connected to a second power supply unit 21.

It is also possible to indicate errors which block data streams to one of the display units or on the system bus by using a connection which is independent of the system bus 7 between the computer 1 and the central display unit 11, and by using a separate power supply unit 20 for said modules. Programs which permit extensive testing and monitoring are provided for the microprocessors 3, 4. Inter alia, the respective other microprocessor and also the communication memory 9 are monitored by each microprocessor. The testing and monitoring programs can be designed to be flexible here, in such a

way that more or fewer tests are executed depending on the respective test results. Thus, for example, it may be provided during normal operation that, in addition to testing some of the modules of the control device, each
5 of the microprocessors 3, 4 tests the other microprocessor. If the other microprocessor fails, however, then the microprocessor that is still operating also tests the modules hitherto tested by the other microprocessor.

After the control device has been switched on, or
10 as long as the printing machine itself has not yet started operating, extensive tests of the individual components are expediently executed in the course of initialization. Supplementary thereto, the operating parameters are then monitored during the operation of the
15 printing machine. As a result it is also possible to detect errors that can only be discovered when the printing machine is running.

Continuous testing of plug connections is possible by virtue of suitable line loops or by monitoring
20 signals (for example clock signals) continuously present on the respective cards.

The flowchart according to Fig. 2 shows essential parts of a test program which is executed after the control device in the microprocessors 3, 4 has been
25 switched on. Following the start at 31, first of all a self-test 32 is carried out which is executed by the respective microprocessor and relates to the respective computer 1, 2. In the event of an error, a corresponding error message is output at 33 and is supplied to the
30 central display unit 11 (Fig. 1) via the serial interface 12 at 34.

If the self-test did not reveal an error, however, the communication memory 9 is tested in program
35 section 35. This is carried out in a manner known per se by writing in information and reading it out again. Again the error is stored and indicated in the event of an error, while if the communication memory 9 is free of errors the other microprocessor is tested in program section 36.

In the exemplary embodiment illustrated, it is assumed that it is generally sufficient to test the respective other microprocessor and not the entire other computer, since the latter has already been tested previously by the other microprocessor.

After the tests on the other microprocessor have been successfully carried out, the further modules are tested at 37. If these are also free of errors the test program is terminated at 38, following which programs for controlling the printing machine are activated. This can in fact also be carried out after the program sections store 33 and display 34 if no errors which prevent correct operation of the printing machine have been discovered up to that point.



Patent claims

1. Device for monitoring an electronic control device for a printing machine having modules (1, 2) connected by means of a bus system (7), at least one
5 memory (5, 6), at least one input and output unit (8), and at least one display device (11, 13, 14), characterized
- in that it has at least two modules (1, 2), one module (1) serving for the central control of the
10 printing machine and another module (2) serving to control the main drive (17, 18, 19),
- in that the modules (1, 2) have at least one processor (3, 4) in each case and a non-volatile memory (5, 6) in each case,
15 - in that the modules (1, 2) have at least one separate interface (12) connected to a central display unit (11),
- and in that each module (1, 2) has a separate power supply unit (20, 21).
- 20 2. Device according to Claim 1, characterized in that each processor (3, 4) is arranged on a separate system card, and in that the processors (3, 4) are connected independently of one another to at least one display means (11, 13, 14) in each case.
- 25 3. Device according to at least one of Claims 1 or 2, characterized in that the system cards with the respective associated display devices (11, 13, 14) are connected to different voltage supply devices (20, 21).
4. Device according to at least one of the preceding
30 claims, characterized in that the device for indicating error states has the display means (11, 13, 14) indicating the normal sequence.
5. Method for monitoring an electronic control device of a printing machine according to at least one of
35 Claims 1 to 4, characterized in that first of all a self-testing of the processors (3, 4) is carried out after switching on, in that after that a read/write memory (9) serving for communication between the processors is successively tested by one of the processors (3, 4) in



each case, and in that a testing of the processors (3, 4) among one another is carried out after the read/write memory (9) has been tested.

5 6. Method according to Claim 5, characterized in that dynamic test runs are executed during operation of the printing machine.

7. Method according to at least one of Claims 5 or 6, characterized in that if a processor (3, 4) fails, the tests, analyses and displays normally to be carried out
10 by the failed processor (3, 4) are carried out by the processor (4, 3) that has not failed.

8. Method according to at least one of Claims 5, 6 or 7, characterized in that the test results are stored in non-volatile memories (5, 6) on the system cards to
15 which the test results relate in each case.

9. Method according to at least one of Claims 5 to 8, characterized in that error messages and/or test results are stored in a non-volatile memory, the latter additionally serving for the communication between the
20 processors (3, 4).

10. Method according to at least one of Claims 5 to 9, characterized in that the error messages are stored in a non-volatile memory and if a further error message occurs, the error message(s) that previously occurred is
25 (are) moved on one position in a non-volatile memory (5, 6).

11. Method according to at least one of Claims 5 to 10, characterized in that the oldest error message from the non-volatile memory (5, 6) is transferred into an
30 additional memory and is stored together with even older error messages.

12. Method according to at least one of Claims 5 to 11, characterized in that operating parameters are stored in non-volatile memory before and during the occurrence
35 of errors.

13. Method according to one of preceding Claims 5 to 12, characterized in that operating parameters present during operation are continuously written into a non-volatile memory, in that operating parameters that have



aged more than a predetermined time are lost, and in that the state of the non-volatile memory is retained if an error occurs.