NASA TECH BRIEF

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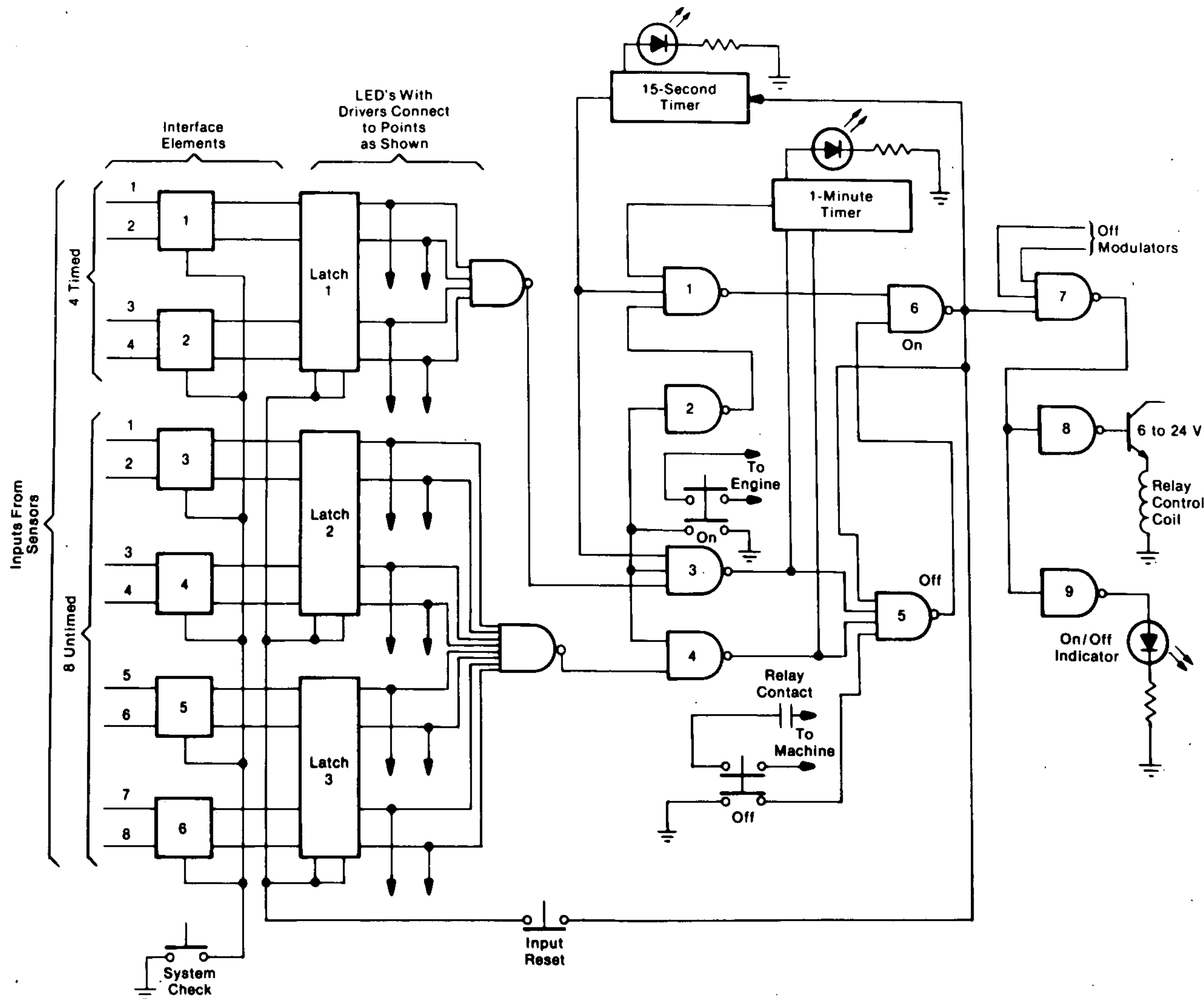
Solid-State Motor Control and Monitor System

The problem:

Relay control systems are used on large motors and internal-combustion engines to provide manual start and stop functions and to shut the engines automatically in case of critical malfunction or out-of-tolerance operation. There are some problems in using these systems. First, relays need periodic replacement due to mechanical wear. Second, because of their size, multifunction control systems with many relays are very bulky. Third, these systems



Motor Control and Monitor System

(continued overleaf)

are frequently hand fabricated to match the requirements of different motor configurations. As a result the systems are expensive: For example, a typical diesel-engine relay system with 8 to 12 functions may cost as much as $5,000.

The solution:

A new compact solid-state system may be used for multifunction motor control. The system can provide 12 control functions for under $100.

How it's done:

The system as shown accepts four timed and eight untimed inputs (some are timed for 15 seconds to disable parameters which are normally out of tolerance on startup). Two momentary contact pushbuttons provide on/off controls. In the example shown, a single relay is used for high-power direct-current interface. A 1-minute timer prevents restart in the event that an out-of-tolerance condition occurs. Latch action stores first-out indication. One pushbutton (system check) simulates an "on" condition for all sensors which checks out the whole system, and another (input reset) resets all inputs unless they are actually out of specification.

Six interface elements receive up to 12 input signals from various remote sensors. They accept voltages from 6 to 50 volts. Because of this rating, the system might be installed directly in place of its relay counterpart without circuit modifications. These elements (e.g., SN-75450, or equivalent) consist of two two-input NAND gates and two transistors (not shown). If 5-volt signals are provided by the sensors, the interface elements are not needed: Either normally-open or normally-closed sensor inputs may be used.

Three 4-bit binary latches (e.g., SN-7475, or equivalent) are utilized to store first-out indications. In the event that an out-of-tolerance failure occurs, the circuitry turns off the controlled machine. A signal is fed back to the latches which disallows any further input reflections on the latch output. For visual monitoring, light-emitting diodes (LED's) may be connected directly to available latch outputs, or inverting drivers and high-output LED's or lamps may be used by connecting to the points shown.

The functions of the remainder of the gates are as follows:

a. Gate 1 determines if all conditions are correct for startup.
b. Gate 2 inverts the start pushbutton signal and provides a one-gate delay of the start indication.
c. Gate 3 provides a "valve action" which times out normally out-of-tolerance sensors on startup and interfaces (as does gate 4) with the start pushbutton to disable stop indications momentarily.
d. Gates 5 and 6 are connected in a flip-flop configuration so that if one is on, the other is off, and vice-versa.
e. Gate 7 allows signals from external sensors (such as a thermostat) to provide a positive off modulation signal. (This will not provide a positive on control if the off pushbutton has been actuated.)
f. Gates 8 and 9 are used as inverter drivers.

The complete system is 7 by 4 by 1.5 inches (17.8 by 10.2 by 3.8 cm). It is easily replaced in case of malfunction. Because it only requires 250-milliamperes, dry-cell batteries may be used for uninterrupted power in case of a primary supply failure.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Johnson Space Center
Code AT3
Houston Texas 77058
Reference: TSP75-10316

Patent status:

NASA has decided not to apply for a patent.

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Categories: 02 (Electronics Systems)
06 (Mechanics)