

been activated for whatever parameter(s) the program has been set up to monitor. The amount of information which the computer can send out by radio depends on the complexity of the coding system set up in the program for this purpose. This paging system is also used during regular shifts to alert the operator when a manual operation, such as adding something to the mix, must be carried out. When the operator performs the operation, he notifies the computer through a panel control, and the computer reassumes control.

Some of the reactions carried out in the 100-gallon reactor involve toxic gases that could endanger operating personnel if concentration levels become too high. An infrared gas analyzer now delivers a 1- to 5-V analog signal to the computer that covers the concentration ranges of interest (zero to extremely hazardous). Air in the vicinity of the reactor is continually sampled and passed through the infrared instrument which is set at one of the major absorption peaks of the toxic material. If the concentration of toxic gas reaches the unsafe limit, an alarm sounds. The whole system can be shifted into automatic shutdown if the level reaches a prescribed value.

#### Computer System

Processing and data storage section of the system's digital control center is a CP212 computer with 8000 words of read-only memory (ROM) and 12,000 words of read/write (R/W) memory. Both memories are random-access core, with 1- $\mu$ s cycle time. Word length is 16 bits.

pc<sup>2</sup> firmware handles all input/output (I/O) operations, including process interrupts and data transfers to peripheral units. An average pc<sup>2</sup> statement, when compiled, generates 10 machine instructions from among a repertoire of 113 provided by micro-ROM (with 250-ns cycle time). The operator uses common English words and standard algebraic conventions to instruct the computer to perform a control task.

If line power fails or primary power falls below minimum input voltage, the computer detects the condition within one cycle and maintains dc power to the processor and memory for 1 ms. This is sufficient to allow completion of the current instruction being executed, storage of the contents of registers in protected memory, and protection of memory content. Auto restart hardware and support software automatically restart the processor and transfer program control to the pc<sup>2</sup> program when power is restored.

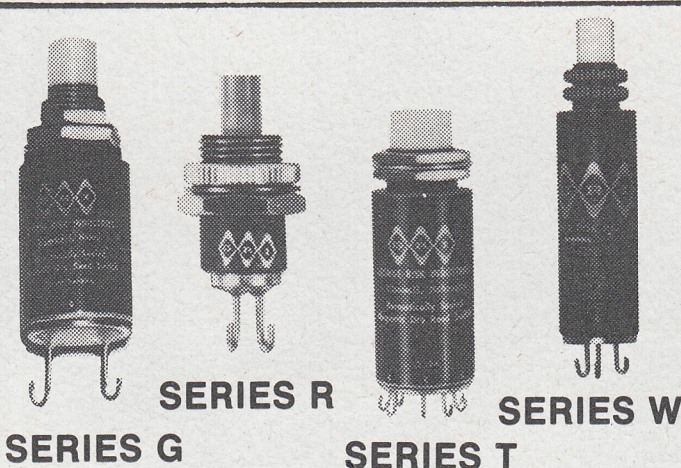
The computer is a 2's complement, binary, parallel machine with hardware multiply/divide for fixed- and floating-point instructions. It contains 16 general-purpose, 16-bit hardware registers, all used as accumulators (15 may be used for indexing); 8 floating-point, 32-bit memory registers; and 16 hardware registers for specific processor operations.

I/O transfer rates are up to 2.67 megabits/s data out or in, and up to 16 megabits/s direct memory access (DMA) (1 million, 16-bit words). An interrupt



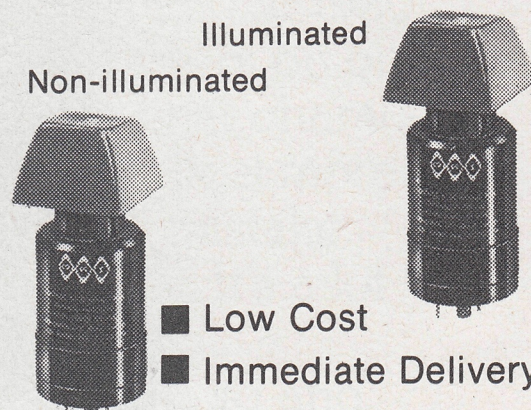
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