Trouble Shooting Microprocessors With "Free Run" Fixtures

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This is the first of a series of articles intended to help games service people detect and cure microprocessor system faults quickly and easily. This will be accomplished with the aid of some inexpensive and easily constructed tools.

When a microprocessor system fails to the point where the self-test will not run, troubleshooting the fault can quickly become extremely difficult. This is due to a simple characteristic common to all microprocessor sytems. That is; the data bus forms part of a complex feedback loop and any error in the loop compounds itself causing all components in the loop to act erractically,whether they are good or not. Signature analysis has been put forth as a sophisticated technique to aid in trouble shooting but even this, requires a predictable core of the system to function in order to be of any use. Free-run fixtures will give you a predictable pattern from the microprocessor allowing orderly troubleshooting.

What exactly does this free run fixture do? A free run fixture forces the processor to cycle continuously through all its addresses. This in turn means that all chip selects are activated with a stable regular signal that you can now use your oscillosope to check. In this manner for instance address decoding can be located. Shorted or open address lines can also be easily detected Address buffers can be checked because we have a predictable signal passing through. The nature of the signal is similar to the output of a 16 stage counter. Address line A0will cycle fastest with Address line A1 at half the speed of A0and so on to address line A15. This regular pattern also will generate a stable data stream for those of you with access to signature analysis.

How does the fixture work? The free run fixture works by isolating the data bus, thereby opening the feedback loop and forcing a hard wired no operation instruction on the data bus at the processor. No matter what address is output by the processor the instruction seen is the same. This forces the program counter to step in a regular fashion through the complete memory space of the system.

Fig 1 shows how a typical free run test fixture is constructed. Figs 2, 3, 4, 5 show the actual connection for 6800, Z80, 6502 and 8080A processors; these being the most common processors at the moment.

To design your own fixture for another processor, all that is required is to wire the no operation (NOP) instruction to the processor and ensure that interrupt and halt and BUS request lines cannot be activated.

Next month I will explain a simple address mapper which can help detect some types of intermittent faults.

Feel free to drop me a line. Your comment will be appreciated along with any questions. I cannot promise to answer each letter individually but will answer those of merit in upcoming articles.

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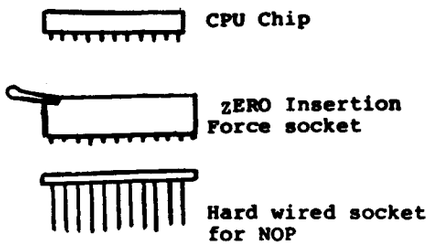

FIG. 1 "FREE RUN" FIXTURE PLUGS INTO GAME CPO SOCKET.

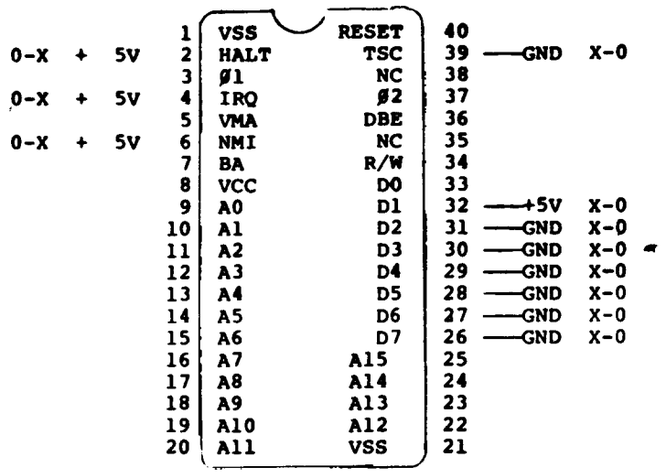

FIG. 2 6800

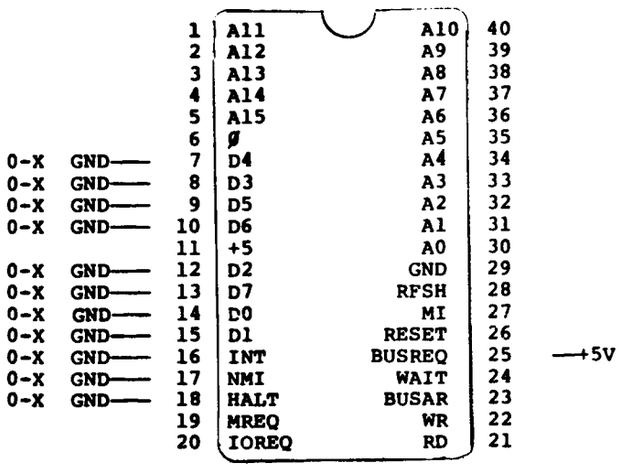

FIG. 3 Z80

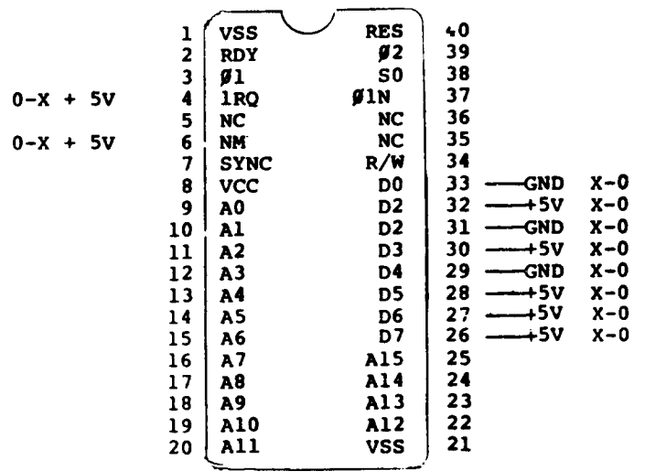

FIG. 4 6502

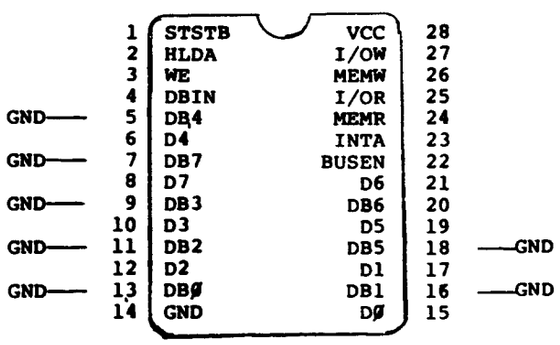

FIG. 5 8228/38 SYSTEM CONTROLLER FOR 8080A

NOTE: Due to the fact that its status signals are multiplexed with data merely cutting the data lines would completely stop its operation. The data lines must therefore be broken "outside" the system controller chip or chips that demultiplex the status and data lines.