Mars Spark Source Prototype Developed

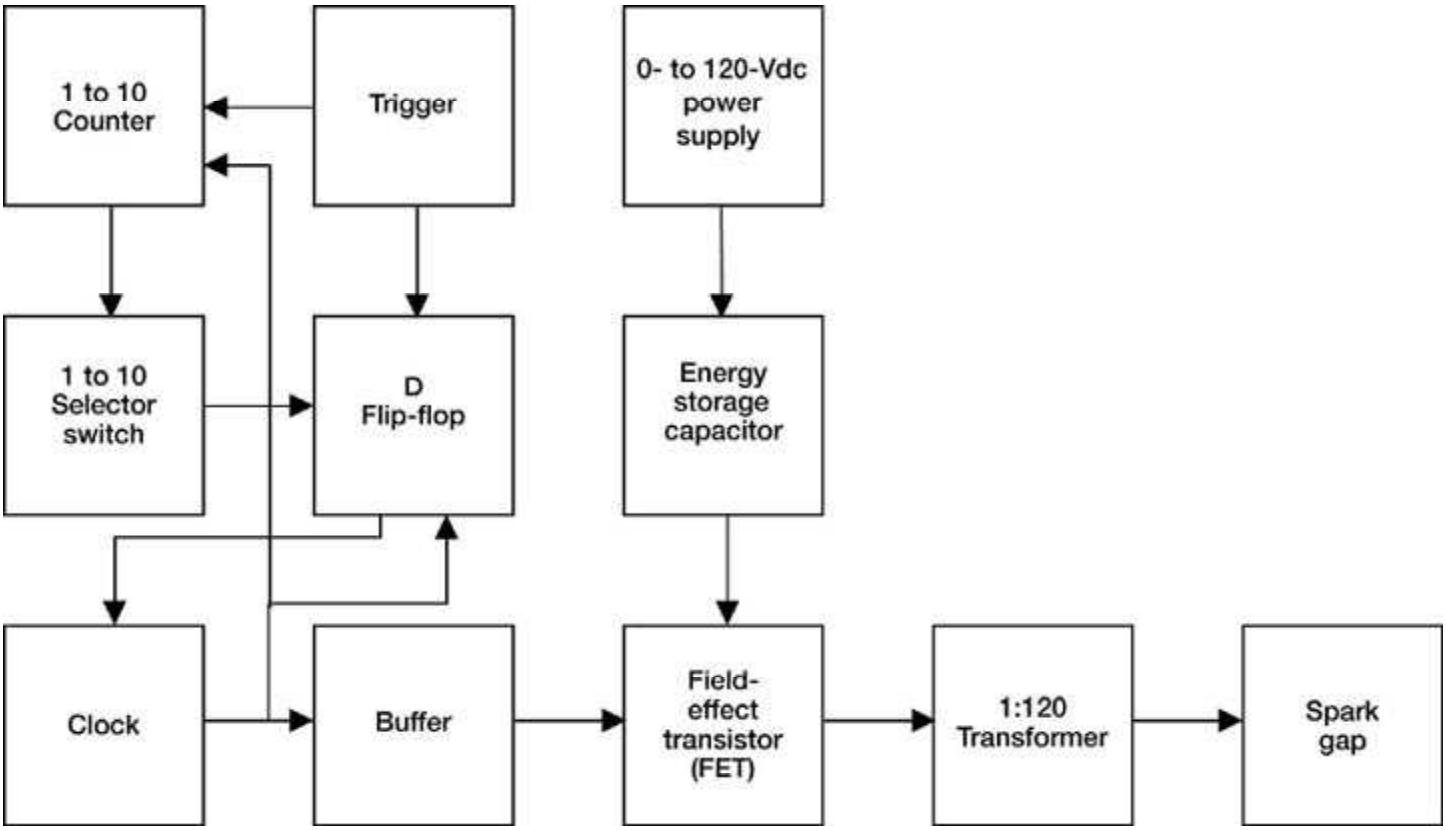
The Mars Spark Source Prototype (MSSP) hardware was developed as part of a proof of concept system for the detection of trace metals such as lead, cadmium, and arsenic in Martian dusts and soils. A spark discharge produces plasma from a soil sample, and detectors measure the optical emission from metals in the plasma to identify and quantify them.

Trace metal measurements are vital in assessing whether or not the Martian environment will be toxic to human explorers. The current method of x-ray fluorescence can yield concentrations of major species only. Other instruments are incompatible with the volume, weight, and power constraints for a Mars mission. The new instrument will be developed primarily for use in the Martian environment, but it would be adaptable for terrestrial use in environmental monitoring.

The NASA Glenn Research Center at Lewis Field initiated the development of the MSSP as part of Glenn's Director's Discretionary Fund project for the Spark Analysis Detection of Trace Metal Species in Martian Dusts and Soils. The objective of this project is to develop and demonstrate a compact, sensitive optical instrument for the detection of trace hazardous metals in Martian dusts and soils.

Glenn built the MSSP hardware, which was developed from inexpensive, readily available commercial components to minimize costs and development time. Miniaturization and optimization of the hardware will greatly improve its efficiency for space applications.

Tests were performed successfully to characterize the prototype's performance in 1 atm of air, in 10 torr of air, and in 10 torr of carbon dioxide (CO_2). A pressure of 10 torr of CO_2 approximates the Martian atmosphere.



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A block diagram of the Mars Spark Source Prototype is shown in the figure. A clock is used to provide a pulse train and adjust the pulse width. The output of the clock is taken to a counter and a flip-flop. Triggering the circuit resets both. A selector switch from the output of the counter selects the desired number of pulses from 1 to 10. After the preset number of pulses has been attained, the flip-flop inhibits the clock until the circuit is triggered again. The output pulses go to a buffer that drives a field effect transistor (FET), which provides power from a 0- to 120-Vdc power supply and an energy storage capacitor to the primary winding of a pulse transformer. The secondary winding of the pulse transformer is connected to the spark gap.

Bibliography

Eichenberg, D.J., et al.: Mars Spark Source Prototype. NASA/TM—1999-209448, 1999.

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