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[54] **NON-INTRUSIVE IN-SYSTEM PROGRAMMING USING IN-SYSTEM PROGRAMMING CIRCUITRY COUPLED TO OSCILLATION CIRCUITRY FOR ENTERING, EXITING, AND PERFORMING IN-SYSTEM PROGRAMMING RESPONSIVE TO OSCILLATION CIRCUITRY SIGNALS**

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[52] **U.S. Cl.** **710/8**; 710/14; 712/32; 712/37; 712/43

[58] **Field of Search** 712/32, 37, 43; 710/8, 14

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[57] **ABSTRACT**

A method and apparatus for In-System Programming which overcomes the above-described disadvantages. The method and apparatus of the ISP system interfaces with the two oscillator (instead of I/O) pins on the microcontroller. By interfacing with the two oscillator pins, the need for extra isolation circuitry to isolate other circuits from the ISP circuits is avoided in most circumstances, without incurring the expense of an expensive JTAG tester or extra dedicated pins. The amount of isolation circuitry necessary is reduced because the two oscillator pins are usually connected to passive components (registers, capacitors, or crystals) which cannot be damaged by the relatively high programming voltages and which do not produce signals that would interfere with the ISP programming signals.

13 Claims, 11 Drawing Sheets