



US006161199A

United States Patent [19]

[11] **Patent Number:** **6,161,199**

Szeto et al.

[45] **Date of Patent:** ***Dec. 12, 2000**

[54] **NON-INTRUSIVE IN-SYSTEM DEBUGGING FOR A MICROCONTROLLER WITH IN-SYSTEM PROGRAMMING CAPABILITIES USING IN-SYSTEM DEBUGGING CIRCUITRY AND PROGRAM EMBEDDED IN-SYSTEM DEBUGGING COMMANDS**

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[73] Assignee: **Scenix Semiconductor, Inc.**, Mountain View, Calif.

Easy Pic'n, A Beginner's Guide to Using PIC 16/17 Micro-controllers; Square 1 Electronics—David Benson, Version 2.0; pp. 1–153.

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

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[21] Appl. No.: **08/989,830**

[57] ABSTRACT

[22] Filed: **Dec. 12, 1997**

An in-system debugging (ISD) capability is incorporated into a production microcontroller. The ISD capability is incorporated without the costly addition of any extra pins to read out the data for debugging by using the oscillator pins of the production microcontroller to read out the data. Building such an ISD capability into the microcontroller, enables debugging to be performed on the actual production board (instead of a special debug board) having the actual production microcontroller (instead of a bond-out microcontroller). This allows designers to debug programming using the actual production system instead of an emulation system.

[51] **Int. Cl.**⁷ **H02H 3/05**

[52] **U.S. Cl.** **714/30; 714/38; 711/103; 710/129; 703/28**

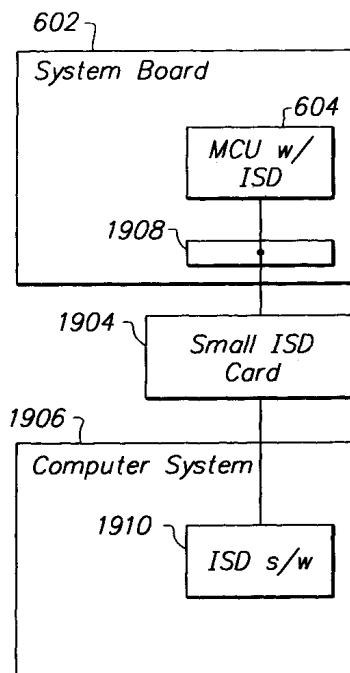
[58] **Field of Search** **395/500; 712/220–232; 710/129; 714/30–36, 38; 364/140.09; 711/103; 703/28**

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20 Claims, 16 Drawing Sheets



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