2 December 1998

Application Notes

USB Keyboard mouse using PDIUSBD11

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Introduction

The PDIUSBD11 (D11) is a high speed USB interface device. It can be interfaced to a micro-controller using a minimum of 3 I/O lines. These are a pair of I^2C lines and an interrupt line.

The D11 can be configured in two modes:

Mode 1 - as a single function.
Mode 2 - as three embedded functions.

Mode 1: Single Function
There are a total of 4 endpoints for a single function configuration. Endpoint 0 (the default Control endpoint) and endpoint 1-3 are generic. They can be used as either interrupt, bulk or control endpoints. Each endpoint has a buffer size of 8 bytes.

Mode 2: 3 Embedded Devices
In the 3 embedded function configuration, each of the 3 functions consists of 2 endpoints: a default Control endpoint 0, and a generic endpoint 1.

The D11 can be used as a HID device (although it is not restricted to just HID use). These application notes show how a keyboard with a PS2 mouse can be used.

HARDWARE DESCRIPTION

The USB Keyboard mouse makes use of Philips D11 and 8051 Micro-Controller (MCU). The keyboard matrix implements 16 output and 8 input MCU lines, as follows:

- I^2C communicates with H11A, using 3 I/O MCU lines.
- PS/2 communicates with the PC 2 I/O MCU lines.
- Num Lock, Caps Lock and Scroll Lock LEDs use 3 I/O MCU lines.
- PS/2 mouse uses 2 I/O MCU lines to generate PS/CLK and PS/DATA.

Firmware description

Files description:

1. **Kbms1_7.asm** is the source file, containing all the routines.
2. **transctn.typ** contains constant values for various transaction codes, between D11 and the Host.
3. **H11.cmd**. contains the I2C commands of the D11A (this file is a subset of H11/H11A commands, and is functionally equivalent).

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USB Class description

The firmware makes use of an HID-compliant composite device. This is a USB device with a single configuration but with two different interfaces. Each interface defines it's own interrupt endpoint and report descriptor.

Interface 0 defines the USB keyboard with endpoint 1 used as the interrupt endpoint for key-pressed data.

Interface 1 links with the USB mouse, using endpoint 2 as the Interrupt endpoint for tracking the movements of the mouse.

Flow Chart

The main loop polls the USB interrupt from the D11; it also runs a routine to detect key-press events.

a) Main loop

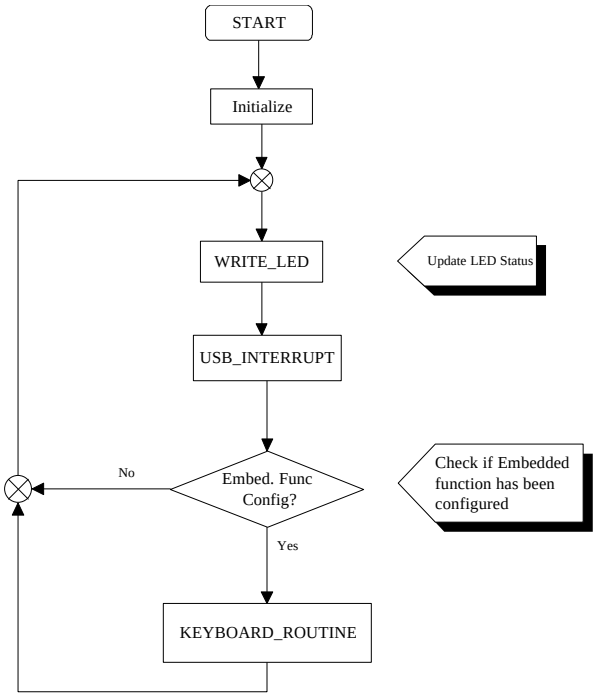

Fig. 1: MAIN ROUTINE

This routine initializes D11 and loops for D11 Interrupt pin to go LOW. The routine branches to USB_INTERRUPT on a HIGH-to-LOW transition on the Interrupt pin.

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b) USB Interrupt

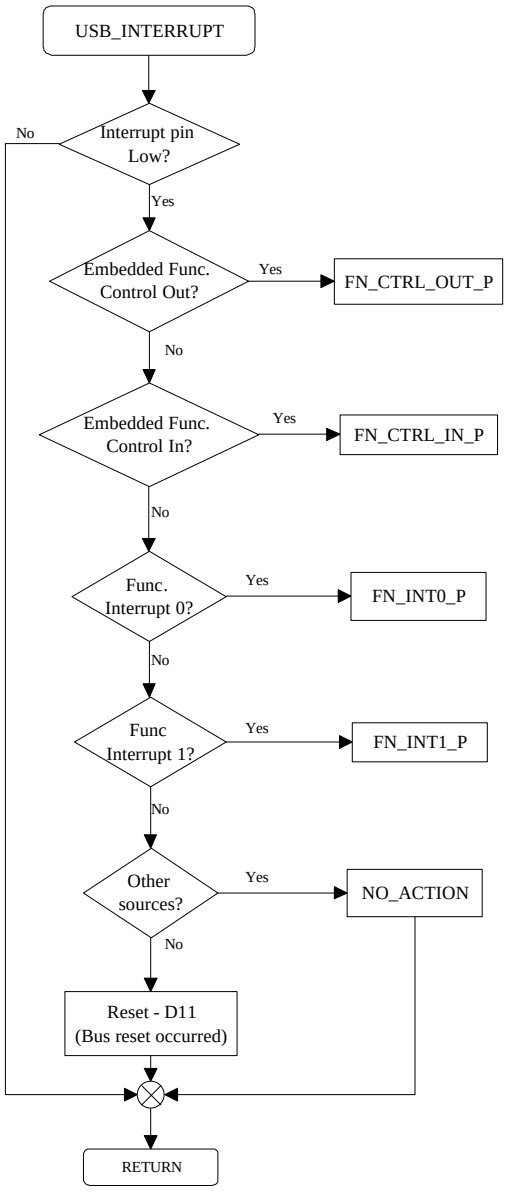

FIG. 2: USB INTERRUPT

This routine checks for the source causing the Interrupt pin to go LOW and branches to the respective routines. The source of the Interrupt can be from:
Embedded_Control_Output_Endpoint
Embedded_Control_Input_Endpoint
Embedded_Interrupt_Endpoint

c) Function Control OUT routine

The deciphered SETUP token is kept as a transaction code which is defined in the file transctn.typ. The actual data transfer is performed by the Function Control IN routine.

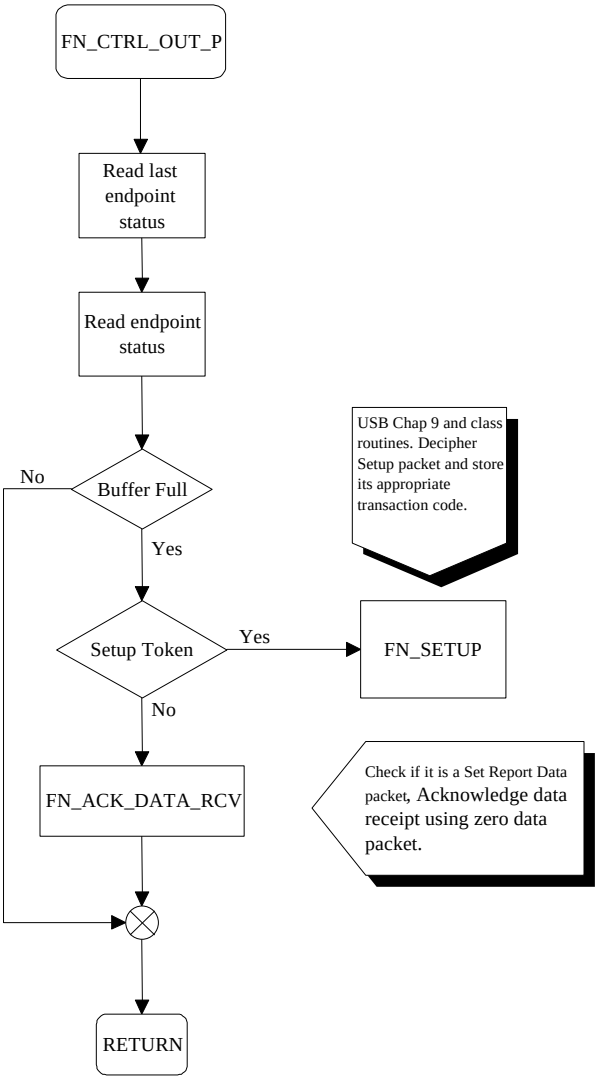

FIG 4: FUNCTION CONTROL OUT

This routine is executed when D11A receives a Setup packet on the upstream. The packet is rejected if all 8 bytes are not received, or if the received packet is not a Setup packet. When a Setup packet is received, the firmware branches to READ_SETUP_DATA to decipher the Setup packet and to execute respective routines.

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d) Function Control IN

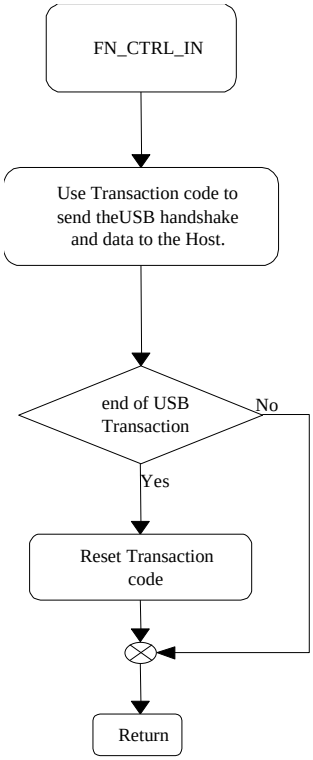

FIG 5: FUNCTION CONTROL IN

This routine is executed when D11 receives an IN token on the upstream. The packet is rejected if all 8 bytes are not received. The firmware branches to MORE_MESSAGES if any data remains from the previous IN token. If the last transaction was SET_ADDRESS, the Hub address is changed to the new address during this transaction.

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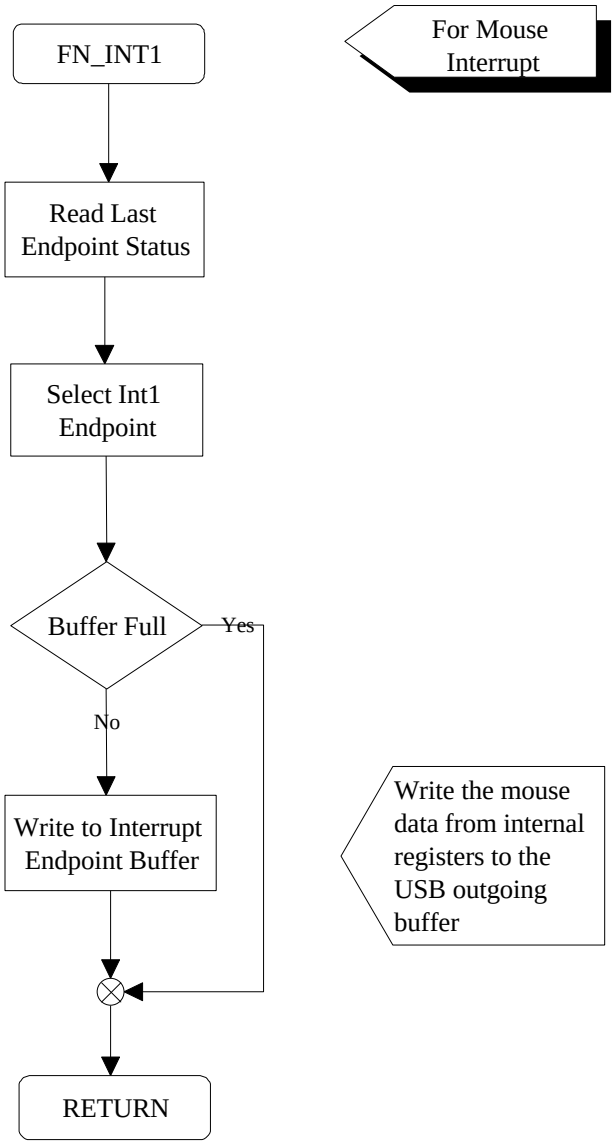
e) Function Interrupt 1.

The mouse interrupt routine is called when each IN token arrives on endpoint 2.



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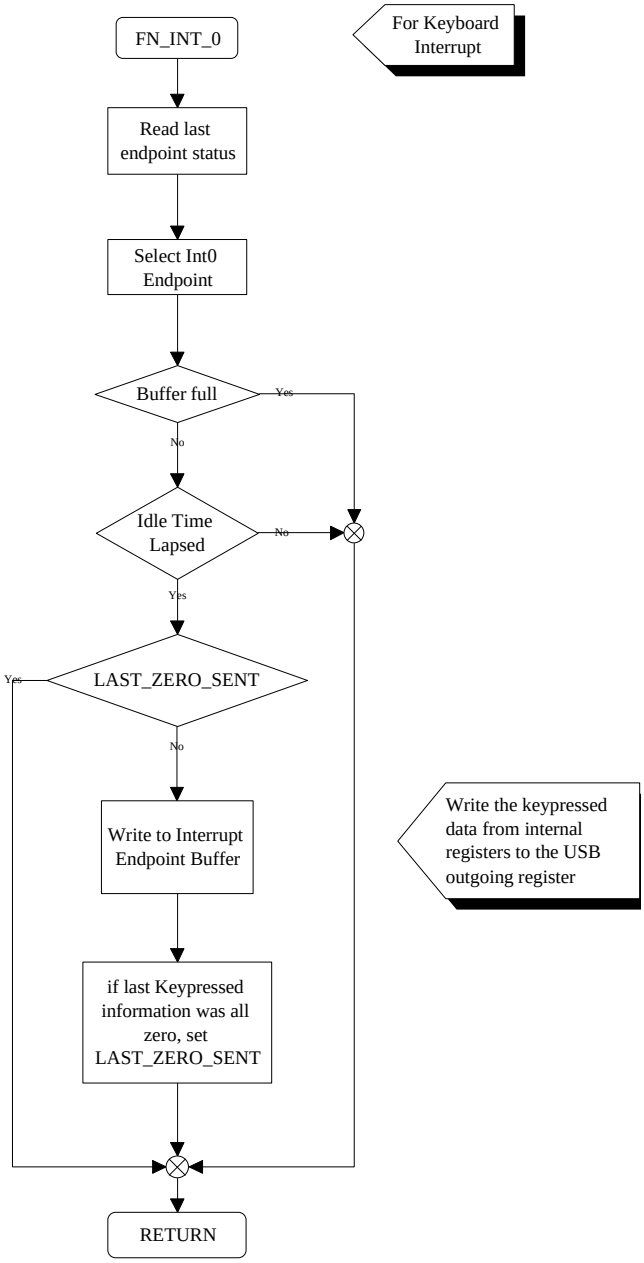
f) Function-Interrupt 0.

D11A should be configured to operate in Debug mode, to enable polling by the Host on a specific endpoint.

In the USB Keyboard Mouse, one of the endpoints is configured as an Input with an Interrupt attribute. This means that D11A generates an Interrupt for every Input token received from the Host on this endpoint.



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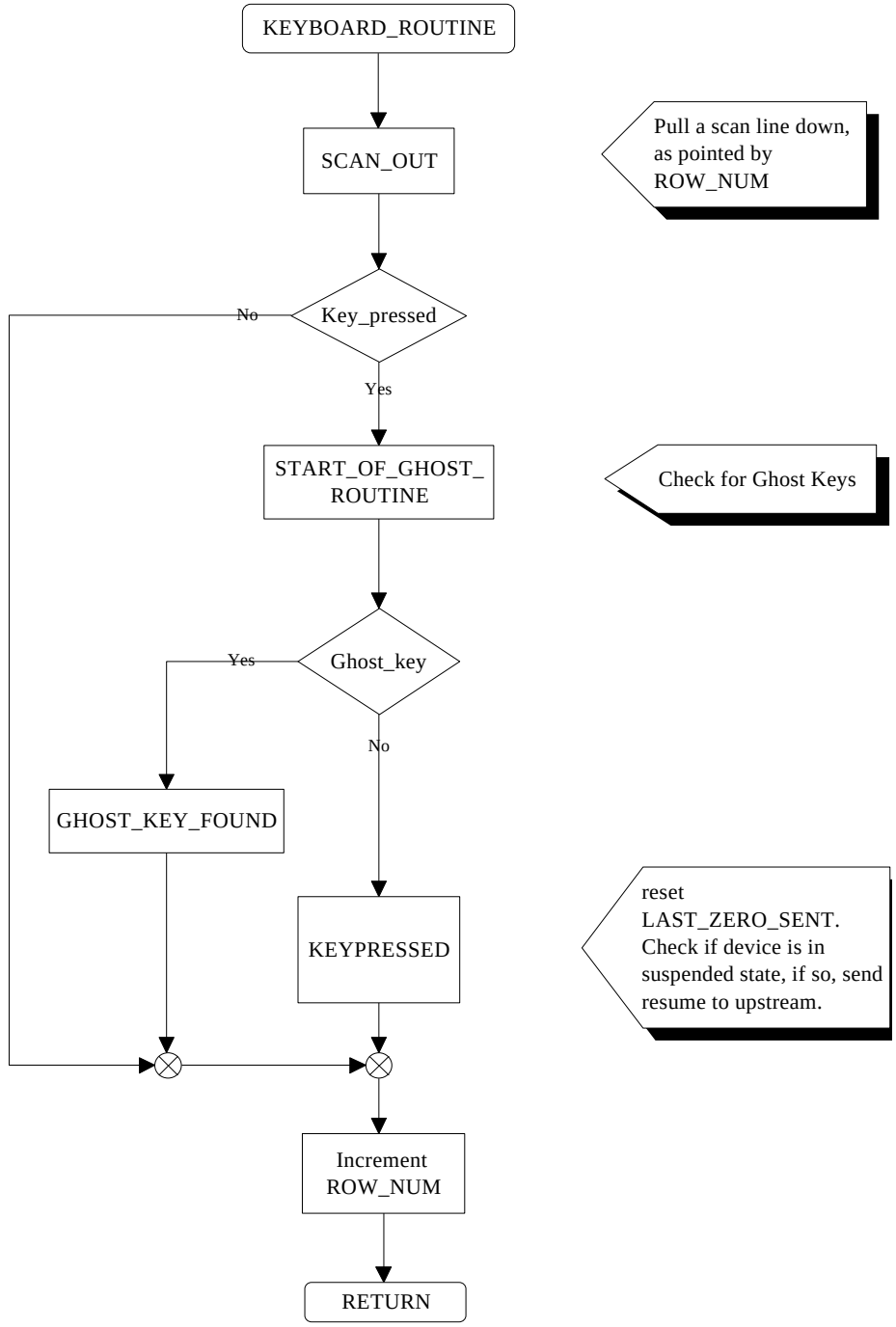
g) Keyboard routine:



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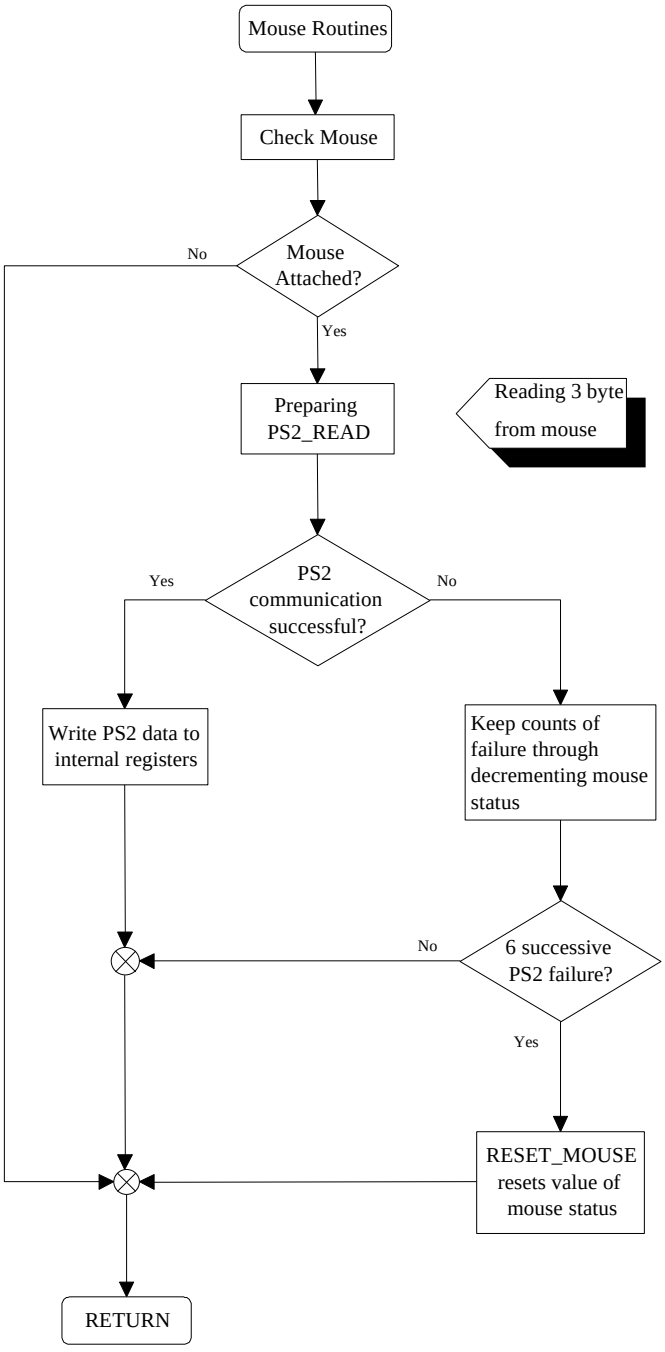
h) Mouse routine:



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Notes on Compatibility

The D11 firmware can be used with an D11 because both are software -compatible. This means that the main Interrupt routine also points to a Hub Interrupt. However, the Interrupt is never called.

If the Interrupt pin is activated without a source from byte 1 of the Interrupt register, this indicates that a BUS reset condition has occurred, since endpoints 8 and 9 are not used in the current configuration. Bus-resets can also be determined by reading the 6^{th} bit of the 2^{nd} byte of the Interrupt register.