MIDI USB PWM Device

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Abstract: - This article describes device for managing any equipment via managing voltage. At the input this device communicates via MIDI and USB protocols. At the output is pulse width modulation. This modulation value is given to value of the third byte in MIDI message. This value is sound power of operative note. There is device is connected as one of USB interfaces at the input. There is device is connected to power transformation device on output. There are PWM managing devices connected as ending equipment.

Key-Words: - PWM, Microchip, MIDI, USB, USB MIDI Event packet,

1 Introduction

Today, MIDI is a part of effects units for all music instruments. Whether are electric guitars, keyboards or some effects for singers or acoustical instruments. MIDI protocol is part of other stage equipment. Consequently MIDI is part of stage lights and artificial smokes. Current development and usage of this protocol especially focuses to music instruments settings and other equipment on stage. Thus, time coordination with other visual effects without human control. In this development, the MIDI protocol is used in combination with the most modern technologies. Very often is used with USB protocol and devices.

Usage of computers in music is standard how for live performance so for music recording. MIDI protocol is the most used for the live performance. It is basic for some setting of musical instruments on the stage. For other equipments, e.g. sound effects too. Some musicians can use MIDI and use it. Some musicians don’t know MIDI, but use MIDI too, because MIDI is standard in electronic musical instruments. MIDI is often one of inner components in keyboards, electrical string instruments or wind MIDI instruments. These MIDI components don’t need human control.

Research target was to design simple, the most inexpensive, simply programmable high variable device. Variability was intended for various lights systems. Important for design was real-time application. Accordingly zero MIDI USB transfer delay for live music performance. Simply put, visual effect must correspondence music performance in real-time. From the begging was evident that it will be one chip device with small requirements for voltage, maintenance and space. There is also a small percentage of failure as an additional criterion for the development of the equipment described below.

2 Solution

2.1 MIDI USB PWM Device

MIDI USB PWM Device plate was designed as a versatile development board for PIC18F2550 microcontroller applications with emphasis on the use of USB microcontrollers. Power board is done via the USB port, which provides a stable 5V. To filter this voltage is added inductance (ferrite seed) and 100μF electrolytic capacitor. Microcontroller itself also contains a stabilizer 3.3V, which is used to stabilize the output 1μF ceramic capacitor. The power supply also connected blocking capacitor 100nF located between GND (ground) and VCC pin of microcontroller.

The source for generating the clock signal is 20MHz XTL with two 15pF ceramic capacitors. The value of the crystal was chosen because of its availability, the actual microcontroller allows the use of crystal in the values (4, 8, 12, 16, 20, 24, 40, 48 MHz). Microcontroller is also equipped with an internal RC oscillator, but using the USB connection you must use the exact source of the clock frequency -
The connectors J2, J3 and J5 are connected input / output pins of the microcontroller. The J2 connector pins are connected RC6 and RC7 - microcontroller serial port and ground. The J3 connector pins are connected to gate B (RB0 - RB7), which are parallel connected to 5V LED series resistor. J5 connector includes pins Gate A (RA0-RA5) and GND. Other connectors on the board's jumper, which is used to activate the bootloader in the normal mode is disconnected, the short-circuited in bootloader mode. The basic program board loader - bootloader has been programmed into the board using an external programmer connected to connector J4, which is represented on the board pads for soldering programmer wires. Reset the microcontroller is connected through resistor 10 k ohms or the power supply. The device has a total of eight functional outputs (channels).
255, for a total of 256 different values. MIDI messages are divided into two basic categories: Status messages and Data messages. Status message determines the type of information that is sent via MIDI. Indicates a device that receives a message that the event belongs to which channel the MIDI event belongs and what it is. It may be an event: Note On, pitch change, Program Change (patch change) and after touch (the last event occurs when it is developed further pressure on already depressed note). Data bytes contained in the device again informed about what values are assigned to events, which carries the status byte.

### 3.1 USB MIDI Event packet
MIDI data is transmitted via USB using 32-bit MIDI Event Packet. Data transmission is performed using the standard reports of four bytes. With this USB MIDI Event Packet is to create a virtual connection between the endpoints USB host and USB MIDI devices. This method of connection is advantageous for its low, which does not require a large number of endpoints, like other types of USB devices. Each MIDI event has its own USB MIDI packet, which prevents creation of many mistakes.

<table>
<thead>
<tr>
<th>CIN</th>
<th>MIDI_x Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0</td>
<td>1, 2 or 3</td>
<td>Vacant value, reserved for others enlargement.</td>
</tr>
<tr>
<td>0x1</td>
<td>1, 2 or 3</td>
<td>Vacant value, reserved for others enlargement.</td>
</tr>
<tr>
<td>0x2</td>
<td>2</td>
<td>Two bytes MIDI messages. E.g. Time Clock or SongSelect</td>
</tr>
<tr>
<td>0x3</td>
<td>3</td>
<td>Three bytes MIDI messages</td>
</tr>
<tr>
<td>0x4</td>
<td>3</td>
<td>MIDI messages System Exclusive type run or continue</td>
</tr>
<tr>
<td>0x5</td>
<td>1</td>
<td>One byte System common or SysEx messages with command end and next one byte information.</td>
</tr>
<tr>
<td>0x6</td>
<td>2</td>
<td>SysEx messages with next two bytes information</td>
</tr>
<tr>
<td>0x7</td>
<td>3</td>
<td>SysEx messages with next three bytes information</td>
</tr>
<tr>
<td>0x8</td>
<td>3</td>
<td>Nota off</td>
</tr>
<tr>
<td>0x9</td>
<td>3</td>
<td>Nota On</td>
</tr>
<tr>
<td>0xA</td>
<td>3</td>
<td>Common pressure sensitivity</td>
</tr>
<tr>
<td>0xB</td>
<td>3</td>
<td>MIDI Control Change</td>
</tr>
<tr>
<td>0xC</td>
<td>2</td>
<td>Program change</td>
</tr>
<tr>
<td>0xD</td>
<td>2</td>
<td>Pressure sensitivity</td>
</tr>
<tr>
<td>0xE</td>
<td>3</td>
<td>Tune change</td>
</tr>
</tbody>
</table>

**Table 1. USB MIDI Event Packet structure**

The first four bytes starting at the MSB position contains information on the number of virtual MIDI cable, which it is transmitted by a given MIDI information. The value of CN is an indication of the range 0x0 through 0xFF indicates the number of the embedded jack, through which there is a link with appropriate MIDI functionality. Second nibl LSB has ended, then identification of the MIDI message. Table 1 shows how different byte write MIDI messages from the USB MIDI packet, which must be submitted if it will be to communicate and receive MIDI information via the USB protocol.
USB MIDI Event Packet is the final part MIDI and USB communication. In the beginning it is necessary that the device is configured and programmed especially visible as a USB interface for the system. Individual sub-categories for this USB device as USB Audio and USB Audio sub-MIDI interface. Various communication interfaces, therefore must be programmed according to these standards.

4 Conclusion
The proposal MIDI USB PWM Device was to create a financially optimized, the cheapest possible, programmable robust equipment. The basic advantage of the device is that of the manufacturing cost. This cost is very low. The device will be available only to the USB connector and a jumper or switch for easy re-programming the application itself for changes in light assembly. An important benefit is the ability to exploit any effect devices, regardless of which protocol is or is not in their software toolkit. The only one prerequisite is to manage the output of the light kit with inductors for large wattage because of reasons of intensity control by pulse width modulation. In this time is developed other new version of hardware device and its management software.

References:
[1] MIDI review [available online]
   <http://www.midi.cz>


   <http://www.usb.org>

   <http://www.usb.org>

   <http://www.usb.org>

   <http://www.microchip.com>

   <http://www.microchip.com>

   <http://www.microchip.com>