LED Control Application Note

1. Introduction

This application note explains how to use the API functions to control the W569x LED. First, it introduces the five control modes, and then it provides program examples.

2. Control Modes

The W569x offers five powerful and easy-to-use modes for LED control. Each mode is selected using the API function W569_LEDControlSource(BYTE bySource).

bySource = 0 : Off

1 : Forced control

2 : Sequence synchronization

3 : MIDI Event

4 : Pattern

Mode 0 (Off) powers down the LED control circuit. Mode 1 (Forced control) uses another API to directly control the LED effect. In Mode 2 (Sequence synchronization), the LED follows one of the MIDI channels, while in Mode 3 (MIDI Event), the LED follows particular unused notes on channel 10. Finally, if the LED is supposed follow a fixed rhythm, Mode 4 provides the Pattern function.

Each mode is described in more detail in the following sub-sections.

2.1 Mode 0

Mode 0 turns off the LED and powers down the LED control circuit. Usually, the W569_Stop command leaves one register open to control the LED, but Mode 0 powers down this port circuit.

2.2 Mode 1

Mode 1 is forced control, which forces the LED to turn on at a specified brightness. The API function W569_SetLEDOnOff(value) controls the level of brightness. The “value” can vary from 0 to 255; 0 turns off the LED. For example,

W569_LEDControlSource(1)

W569_SetLEDOnOff(0)

………………..

W569_SetLEDOnOff(255)

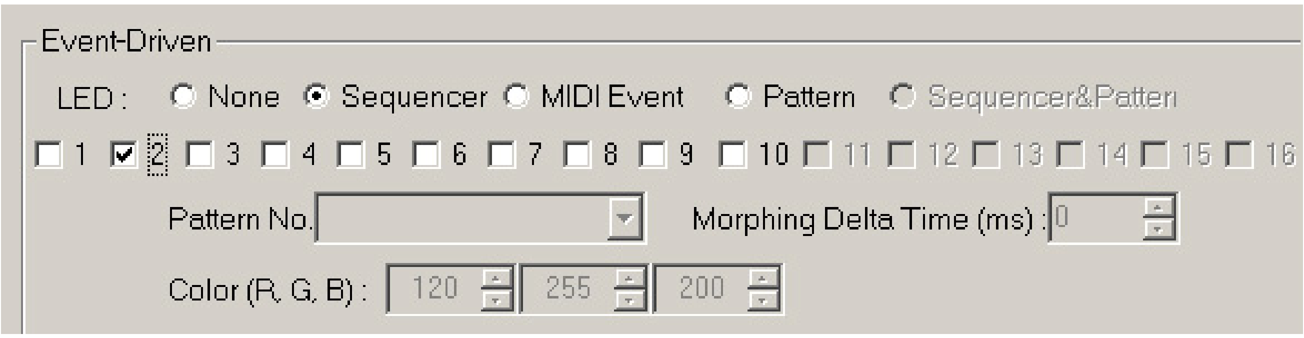
Once turned on, the LED does not turn off until the value is set to zero or the control mode changes.

Forced control is also effective when the IC is powered down, but it behaves a little differently. In power-down mode, it is possible to turn the LED on and off but not to control the level of brightness. Every value greater than zero (i.e., 1 ~ 255) only turns on the LED, while zero turns it off.

2.3 Mode 2

Mode 2 is sequence mode. In sequence mode, the LED turns on and off synchronized with the channel notes. The API function W569_SetLEDRGB() controls the level of brightness. The “value” can vary from 0 to 255, and the default is 255.

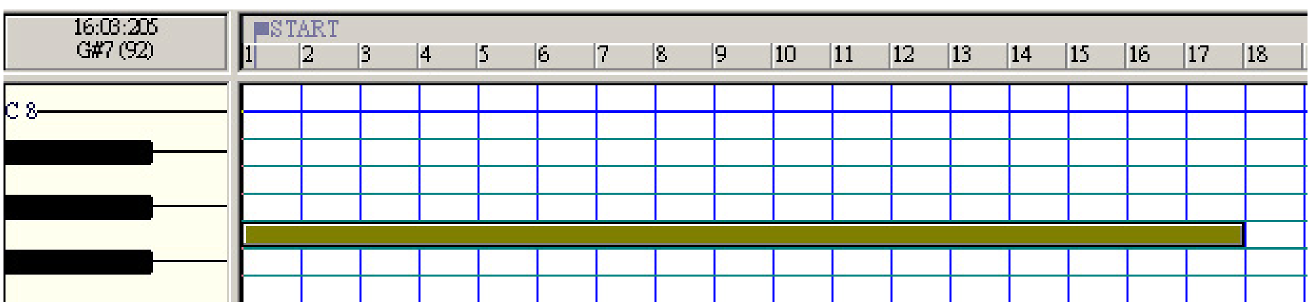
The midi file must be setup correctly using the ringtone player tool for this mode to be effective. First, open the midi file. Then, select the “Sequencer” radio button, and select the appropriate channel(s). (The W5691 only allows one-channel synchronization, while the W56940 and W56964 support multiple channels.) Lastly, convert the midi file to XMF.



Then, by selecting Mode 2 and playing this midi file, the LED is synchronized with the notes.

2.4 Mode 3

Mode 3 is event mode, in which the LED is controlled by midi events. Midi events are otherwise-unused notes that represent LED activity. These notes must be prepared in advance using a midi editor, like cakewalk. Create the notes at the desired times using note A7 (decade 93), G#7 (decade 92), or G7 (decade 91) on channel 10. The level of brightness is controlled by the velocity, which varies from 0 to 127. One example is shown below.



This midi file should be converted to XMF, selecting “MIDI Event” in the ringtone player. Then, by selecting Mode 3 and playing this midi file, the LED turns on and off based on the events.

2.5 Mode 4

Mode 4 is pattern mode. The pattern is based on a table that contains the LED run-time and the level of brightness for each part of the pattern. (An example is provided in section 3.1.) Then, the location of this table is provided to API function W569_SetLEDPattern to build the pattern. Whenever midi is playing, the LED follows the specified pattern, repeating it until the midi sound stops. If no sound is playing, the LED does not turn on.

The pattern can be morphed. Morphing makes the changes in brightness more gradual by increasing or decreasing the brightness level in steps. The morphing time is the duration of each step. For example, if one part of the pattern lasts 500 ms and the morphing time is 50 ms, the brightness changes (linearly) from the beginning level to the final level in ten (500 ms / 50 ms) steps. The shorter the morphing time, the more gradual the change in brightness, but the effect diminishes as morphing time becomes really small. The morphing time is specified in W569_SetLEDPattern.

3. Implementation

This section provides program examples and frameworks for controlling the W569x LED in different command modes.

First, it begins with a reminder to set the control mode again for different channels. Consider this example:

Example :

```
W569_LEDControlSource(2);
W569_Play( midi 1 );
…………..
W569_Play( midi 2 );
…………..
W569_Play( midi 3 );
…………..
W569_LEDControlSource(0);
W569_Play(midi 4);
…………..
```

This program sets the control mode and channel before midi 1 and not before midi 2 or midi 3. If midi 1 synchronizes with the LED on channel 5, the LED tries to synchronize with midi 2 on channel 5 as well. If midi 2 does not use channel 5, the W569x uC turns off the LED to save power and does not turn it on again when midi 2 finishes. As a result, if midi 3 uses channel 5, the twinkle will run synchronize with midi 3 again. This applies to event mode and pattern mode as well. If this behavior is not desired, change the control mode before midi 2 and midi 3; i.e., use the W569_LEDControlSource command again.

3.1 Source Coding

This section provides several examples of programs that control the LED in different situations. A general framework is provided below.

The rest of this section provides program examples, separated by remark or comment statements. Please note that W569_initialize is only shown once because all of these examples are shown as part of the same program. If the examples are divided into separate programs, W569_initialize should be included at the beginning of each one.

```
/*---------------------------------------------------------------*/
//To force control twinkle at power down mode
/*---------------------------------------------------------------*/
SetW569IOMapping();
nRet = W569_Initialize();

W569_LEDControlSource(1);
W569_SetLEDOnOff( 1 );
……
W569_SetLEDOnOff( 0) ;
……..
```

```
/*---------------------------------------------------------------*/
//play sound and force control twinkle
/*---------------------------------------------------------------*/
W569_LEDControlSource(1);
ID=W569_Play(playdata1,sizeof(g_abysound2),1);
while(W569_IsPlaying(ID))
{
W569_SetLEDOnOff( 255 );
…….
W569_SetLEDOnOff( 0) ;
……..
}
W569_Stop(ID)

/*-----------------------------------------------------------*/
//play midi with sequence synchronization
/*-----------------------------------------------------------*/

W569_SetLEDBlinking(1);
W569_SetLEDRGB(150,0,0);
W569_LEDControlSource(2);
ID=W569_Play(playdata2,sizeof(g_abysequence),1);
while(W569_IsPlaying(ID));
W569_Stop(ID)

/*-----------------------------------------------------------*/
//play midi with midi event
/*-----------------------------------------------------------*/

W569_SetLEDBlinking(1);
W569_LEDControlSource(3);
ID=W569_Play(playdata3,sizeof(g_abyevent),1);
while(W569_IsPlaying(ID));
W569_Stop(ID)
```

```
/*------------------------------------------------------------*/
//play midi with LED pattern
/*-----------------------------------------------------------*/
BYTE abyLEDPlayPattern[] =
{
        0xF4, 0x01,             /* 500 ms (until brightness is 255, 0, 0) */
        0xFF, 0x00, 0x00,       /* (R,G,B) = (255, 0, 0) */
        0xF4, 0x01,             /* 500 ms (until brightness is 0, 255, 0) */
        0x00, 0xFF, 0x00,       /* (R,G,B) = (0, 255, 0) */
        0xF4, 0x01,             /* 500 ms (until brightness is 0, 0, 255) */
        0x00, 0x00, 0xFF,       /* (R,G,B) = (0, 0, 255) */
        0x00, 0x00              /* end of pattern */
};
BYTE *LEDpattern=abyLEDPlayPattern;
W569_SetLEDBlinking(1);
W569_SetLEDPattern(LEDpattern,50);
W569_LEDControlSource(4);
ID=W569_Play(playdata4,sizeof(g_abypattern),1);
while(W569_IsPlaying(ID));
W569_Stop(ID)
```

4. W569CY and W5691BY Differences

The definition of high-active and low-active is reversed. This is a setting that affects control modes 1 and 4 and is maintained in MWstd.h.

Prototype	#define LED_LOW_ACTIVE 0	
Description	Set LED output in high-active or low-active	
Value	0	LED is high-active
	1	LED is low-active

In the W569CY, high-active means higher values correspond to brighter LEDs; 0 turns off the LED, and 255 is the brightest level. In the W5691BY, however, high-active means higher values correspond to dimmer LEDs; 0 is the brightest level, and 255 turns off the LED. Low-active is always the opposite of high-active. The examples in the rest of this document are based on W569CY LEDs that are high-active or W5691BY LEDs that are low-active—0 turns off the LED, and 255 is the brightest level.

High-active and low-active have no meaning in control modes 2 or 3. In control modes 2 and 3, higher values correspond to brighter LEDs, regardless of the version or setting in MWstd.h.

This reversal creates another difference right after power-on. The setting in MWstd.h is not enforced until W569_initialize is called. Until then, the defaults—high-active and brightness level 0—are used, but the combined effect of these settings is the opposite because the definition of high-active is reversed. As a result, the W569CY LED is initially turned off, while the W5691BY LED initially turns on at the brightest level. Before initialize there is a most difference, the W5691BY vibrator output pin is high but W5691CY is low.

5. Revision History

Revision	Date	Modifications
A0	January 2005	• Preliminary release
A1	March 2005	• Add Disclaimer

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