

# **USB5841**

## **User's Manual**

 **Beijing ART Technology Development Co., Ltd.**

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## Chapter 1 Overview

USB5841 can be widely used in count, timing, frequency measurement, frequency occurrence, digital control, especially in the count, frequency measurement fields can be flexible and convenient combination to meet the different needs of a variety of users. The channel 0 provide positive/reverse output, you can easily control the GATE of the other channels, in order to facilitate frequency measurement applications.

### Unpacking Checklist

Check the shipping carton for any damage. If the shipping carton and contents are damaged, notify the local dealer or sales for a replacement. Retain the shipping carton and packing material for inspection by the dealer.

Check for the following items in the package. If there are any missing items, contact your local dealer or sales.

- USB5841 Data Acquisition Board
- ART Disk
  - a) user's manual (pdf)
  - b) drive
  - c) catalog
- Warranty Card

## FEATURES

### Digital Input/Output

- Channel No.: 48-channel (each 8 channels can be configured to DI or DO)
- Electric Standard: TTL compatible
- Digital Input: High Voltage:  $\cong 2.0V$   
Low Voltage:  $\cong 0.8V$
- Digital Output: High Voltage:  $\cong 4.45V$   
Low Voltage:  $\cong 0.5V$   
Power-on output: low level

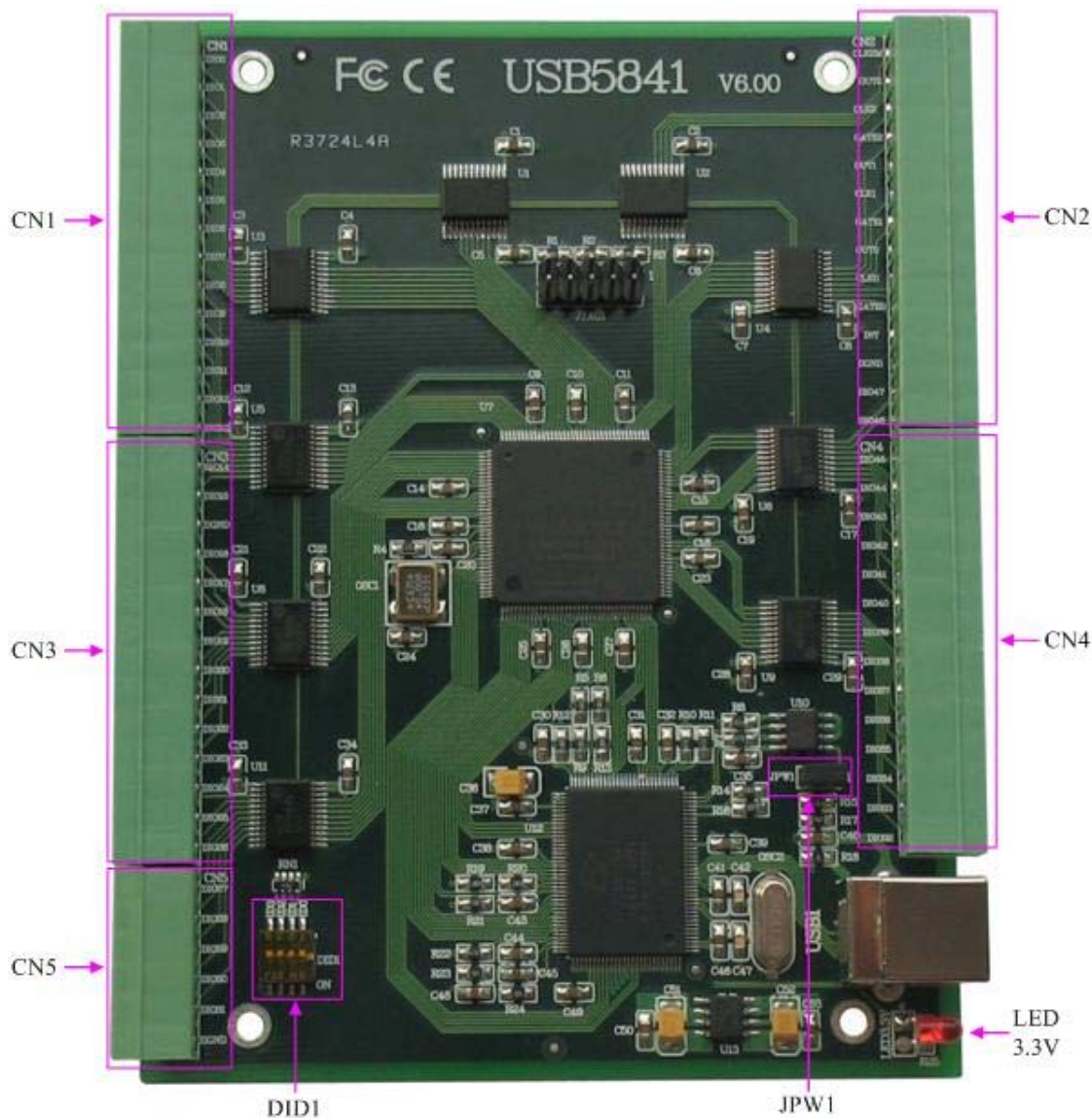
### Counter

- 32-bit resolution
- Channel No.: 3-channel subtracting counters
- Counting Mode: 6 counting mode (software-configurable)
- Electrical Standard: TTL level
- Clock Source (CLKn): 1Hz~10MHz
- Gate (GATEn): Rising, high-level and low-level
- Counter Output (OUTn): high-level, low-level

**Dimension:** 128mm (L) \* 95.5mm (W) \* 14mm (H)

## Chapter 2 Components Layout Diagram and a Brief Description

### 2.1 The Main Component Layout Diagram



### 2.2 The Function Description for the Main Component

#### 2.2.1 Signal Input and Output Connectors

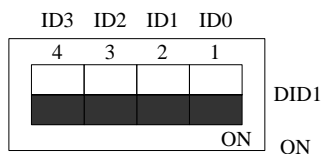
- CN1: DIO0~DIO13 digital signal input/output connector
- CN2: DIO46~DIO7 digital signal input/output, interrupt signal and Timer/Counter connector
- CN3: DIO14~DIO26 digital signal input/output connector
- CN4: DIO32~DIO45 digital signal input/output connector
- CN5: DIO27~DIO31 digital signal input/output and interrupt signal connector

### 2.2.2 Jumper

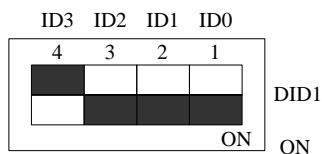
JPW1: load USB controller program, 1-2 shorted (default)

### 2.2.3 Physical ID of DIP Switch

DID1: Set physical ID number. When the PC is installed more than one USB5841 , you can use the DIP switch to set a physical ID number for each board, which makes it very convenient for users to distinguish and visit each board in the progress of the hardware configuration and software programming. The following four-byte numbers are expressed by the binary system: When DIP switch points to "ON", that means "1", and when it points to the other side, that means "0." As they are shown in the following diagrams: byte "ID3" is the high byte."ID0" is the low byte, and the black part in the diagram represents the location of the switch. (Test software of the company often uses the logic ID management equipments and at this moment the physical ID DIP switch is invalid. If you want to use more than one kind of the equipments in one and the same system at the same time, please use the physical ID as much as possible.).



The above chart shows "1111", so it means that the physical ID is 15.



The above chart shows "0111", so it means that the physical ID is 7.



The above chart shows "0101", so it means that the physical ID is 5.

ID3	ID2	ID1	ID0	Physical ID (Hex)	Physical ID (Dec)
OFF (0)	OFF (0)	OFF (0)	OFF (0)	0	0
OFF (0)	OFF (0)	OFF (0)	ON (1)	1	1
OFF (0)	OFF (0)	ON (1)	OFF (0)	2	2
OFF (0)	OFF (0)	ON (1)	ON (1)	3	3
OFF (0)	ON (1)	OFF (0)	OFF (0)	4	4
OFF (0)	ON (1)	OFF (0)	ON (1)	5	5
OFF (0)	ON (1)	ON (1)	OFF (0)	6	6
OFF (0)	ON (1)	ON (1)	ON (1)	7	7
ON (1)	OFF (0)	OFF (0)	OFF (0)	8	8
ON (1)	OFF (0)	OFF (0)	ON (1)	9	9
ON (1)	OFF (0)	ON (1)	OFF (0)	A	10

ON (1)	OFF (0)	ON (1)	ON (1)	B	11
ON (1)	ON (1)	OFF (0)	OFF (0)	C	12
ON (1)	ON (1)	OFF (0)	ON (1)	D	13
ON (1)	ON (1)	ON (1)	OFF (0)	E	14
ON (1)	ON (1)	ON (1)	ON (1)	F	15

### 2.2.4 Indicator Status

LED3.3V: 3.3V power indicator, on for normal.

## Chapter 3 Signal Connectors

### 3.1 The Definition of Signal Input and Output Connectors

Pin definition

CN1	<input type="checkbox"/>	DIO0	CLK2M	<input type="checkbox"/>	CN2
	<input type="checkbox"/>	DIO1	OUT2	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO2	CLK2	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO3	GATE2	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO4	OUT1	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO5	CLK1	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO6	GATE1	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO7	OUT0	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO8	CLK0	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO9	GATE0	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO10	INT	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO11	DGND	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO12	DIO47	<input type="checkbox"/>	
<input type="checkbox"/>	DIO13	DIO46	<input type="checkbox"/>		
CN3	<input type="checkbox"/>	DIO14	DIO45	<input type="checkbox"/>	CN4
	<input type="checkbox"/>	DIO15	DIO44	<input type="checkbox"/>	
	<input type="checkbox"/>	DGND	DIO43	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO16	DIO42	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO17	DIO41	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO18	DIO40	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO19	DIO39	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO20	DIO38	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO21	DIO37	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO22	DIO36	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO23	DIO35	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO24	DIO34	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO25	DIO33	<input type="checkbox"/>	
	<input type="checkbox"/>	DIO26	DIO32	<input type="checkbox"/>	
CN5	<input type="checkbox"/>	DIO27			
	<input type="checkbox"/>	DIO28			
	<input type="checkbox"/>	DIO29			
	<input type="checkbox"/>	DIO30			
	<input type="checkbox"/>	DIO31			
	<input type="checkbox"/>	DGND			

Pin definition about CN1, CN3, CN4, and CN5:

Pin name	Type	Pin function definition
DIO0~DIO47	Input/ Output	48-channel digital input/output.
GND	GND	Ground.

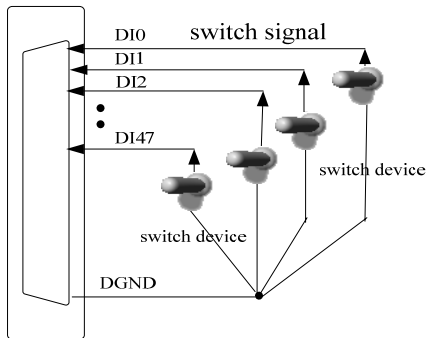
Pin definition about CN2 (Timer/Counter):

Pin Name	Feature	Function Definition
CLK2M	Output	On-board 2MHz clock oscillator pulse output, Output cycle 0.5 microseconds.
CLK0~CLK2	Input	Clock/pulse input pins
GATE0~GATE2	Input	Gate input pins
OUT0~OUT2	Output	Output pins
DGND	GND	Digital ground, when use counter/timer we best choose it as reference ground.
INT	Input	Interrupt signal input.

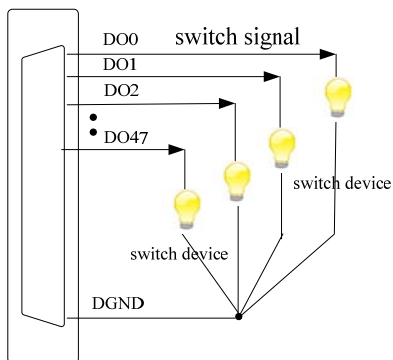


## Chapter 4 Connection Ways for Each Signal

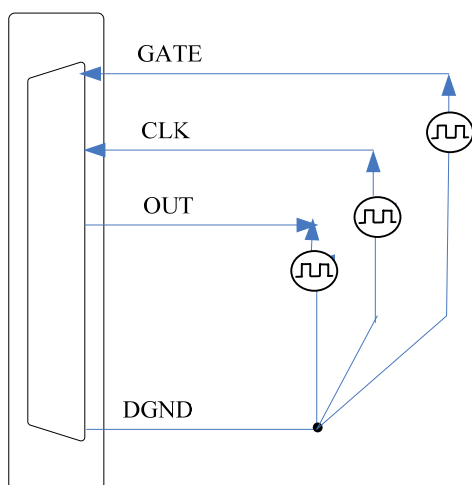
### 4.1 Digital Input Connection



### 4.2 Digital Output Connection



### 4.3 Timer/Counter Connection



## *Chapter 5 Methods of Using Timer/Counter*

### **5.1 The working mode**

#### **MODE 0 Interrupt on terminal count**

Mode 0 is typically used for event counting. After the Control Word is written, OUT is initially low, and will remain low until the Counter reaches zero. OUT then goes high and remains high until a new count or a new Mode 0 Control Word is written into the Counter.

GATE=1 enables counting; GATE=0 disables counting. GATE has no effect on OUT.

After the Control Word and initial count are written to a Counter, the initial count will be loaded on the next CLK pulse. This CLK pulse does not decrement the count, so for an initial count of N, OUT does not go high until N+1 CLK pulses after the initial count is written.

If a new count is written to the Counter, it will be loaded on the next CLK pulse and counting will continue from the new count. If a two-byte count is written, the following happens:

- 1) Writing the first byte disables counting. OUT is set low immediately (no clock pulse required)
- 2) Writing the second byte allows the new count to be loaded on the next CLK pulse

This allows the counting sequence to be synchronized by software. Again, OUT does not go high until N+1 CLK pulses after the new count of N is written.

If an initial count is written while GATE=0, it will still be loaded on the next CLK pulse. When GATE goes high, OUT will go high N CLK pulse later, no CLK pulse is needed to load the Counter as this has already been done.

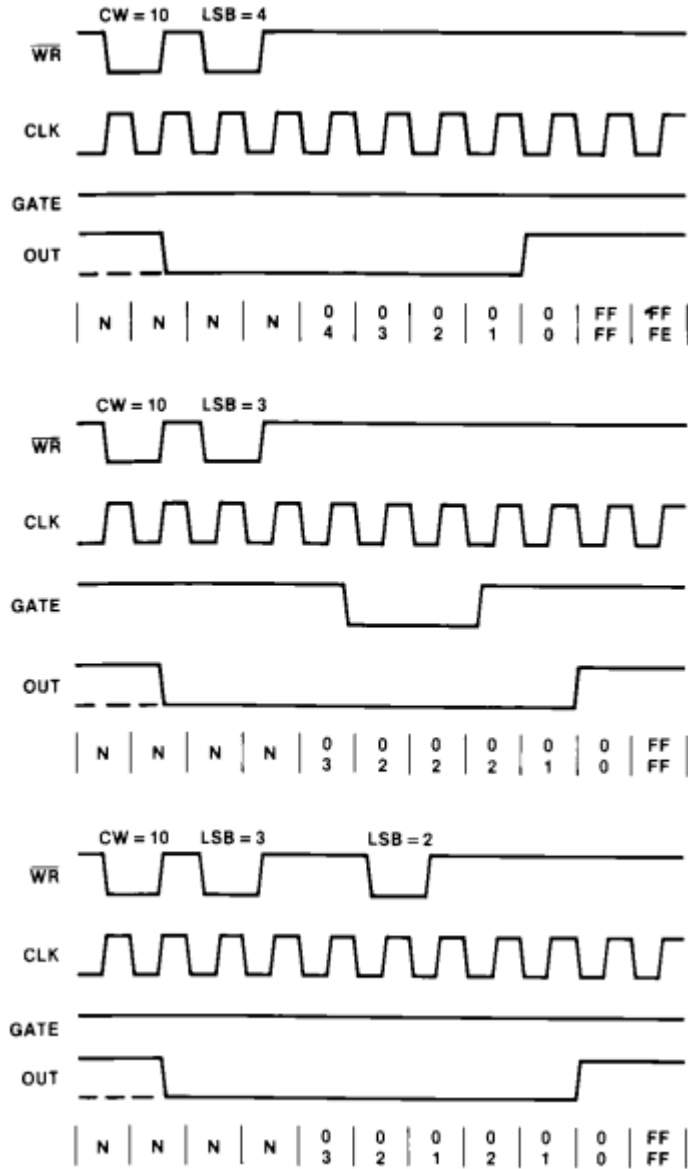


Figure 5.1 Mode 0

**NOTE**

*The following conventions apply to all mode timing diagrams*

1. Counters are programmed for binary (not BCD) counting and for reading/writing least significant byte (LSB) only.
  2. The counter is always selected ( $\overline{CS}$  always low)
  3. CW stands for "Control Word"; CW=10 means a control word of 10 HEX is written to the counter.
  4. LSB stands for "Least Significant Byte" of count.
  5. Numbers below diagrams are count values. The lower number is the least significant byte. The upper number is the most significant byte. Since the counter is programmed to read/writer LSB only, the most significant byte cannot be read.
- N stands for an undefined count.  
Vertical lines show transitions between count values.

**MODE 1 Hardware retriggerable one-shot**

OUT will be initially high. OUT will go low on the CLK pulse following a trigger to begin the one-shot pulse, and will remain low until the Counter reaches zero.

OUT will then go high and remain high until the CLK pulse after the next trigger.

After writing the Control Word and initial count, the Counter is armed. A trigger results in loading the Counter and setting OUT low on the next CLK pulse, thus starting the one-shot pulse. An initial count of N will result in a one-shot pulse N CLK cycles in duration. The one-shot is retriggerable, hence OUT will remain low for N CLK pulses after any trigger. The one-shot pulse can be repeated without rewriting the same count into the counter. GATE has no effect on OUT.

If a new count is written to the Counter during a one-shot pulse, the current one-shot is not affected unless the counter is retriggered. In that case, the Counter is loaded with the new count and the one-shot pulse continues until the new count expires.

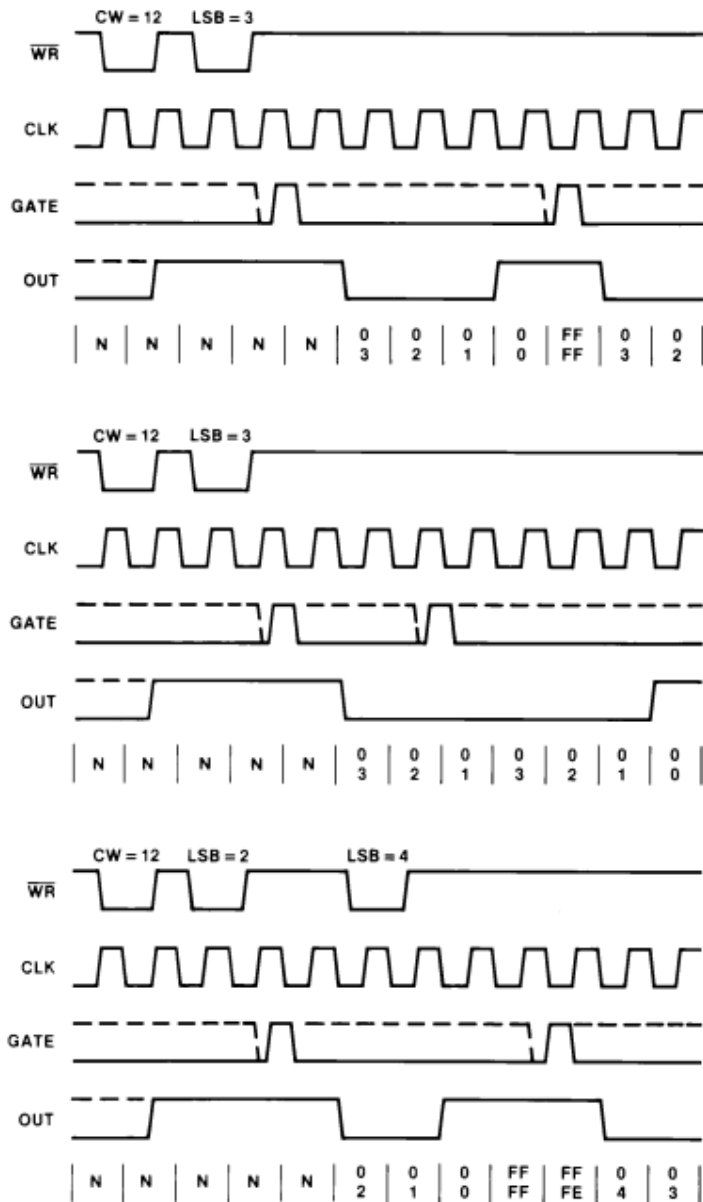


Figure 5.2 Mode 1

**MODE 2 Rate Generator**

This Mode functions like a divide-by-N counter. It is typically used to generate a Real Time Clock interrupt. OUT will initially be high. When the initial count has decremented to 1, OUT goes low for on CLK pulse. OUT then goes high again, the Counter reloads the initial count and the process is repeated. Mode 2 is periodic; the same sequence is repeated indefinitely. For an initial count of N, the sequence repeats every N CLK cycles.

GATE=1 enables counting; GATE=0 disables counting. If GATE goes low during an output pulse, OUT is set high immediately. A trigger reloads the Counter with the initial count on the next CLK pulse; OUT goes low N CLK pulses after the trigger. Thus the GATE input can be used to synchronize the Counter.

After writing a Control Word and initial count, the Counter will be loaded on the next CLK pulse. OUT goes low N CLK Pulses after the initial count is written. This allows the Counter to be synchronized by software also.

Writing a new count while counting does not affect the current counting sequence. If a trigger is received after writing a new count but before the end of the current period, the Counter will be loaded with the new count on the next CLK pulse and counting will continue from the new count. Otherwise, the new count will be loaded at the end of the current counting cycle. In mode2, a COUNT of 1 I illegal.

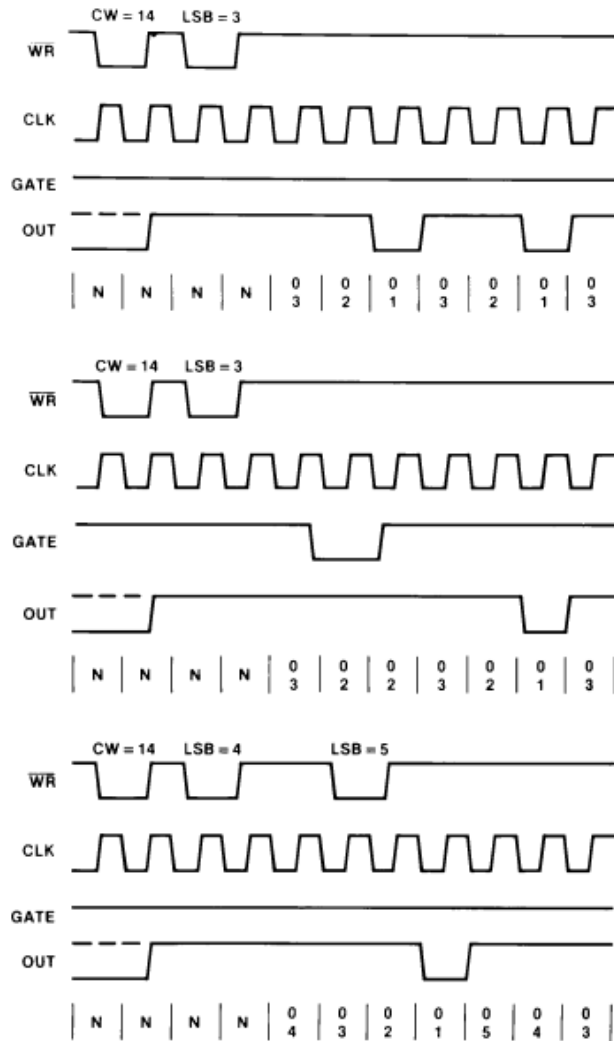


Figure 5.3 Mode 2

*Note: A GATE transition should not occur one clock prior to terminal count.*

**MODE 3 Square wave mode**

Mode 3 is typically used for Baud rate generation. Mode 3 is similar to Mode 2 except for the duty cycle of OUT. OUT will initially be high. When half the initial count has expired, OUT goes low for remainder of the count. Mode 3 is periodic; the sequence above is repeated indefinitely. An initial count of N results in a square wave with a period of N CLK cycles.

GATE=1 enables counting; GATE=0 disables counting. If GATE goes low while OUT is low, OUT is set high immediately; no CLK pulse is required. A trigger reloads the Counter with the initial count on the next CLK pulse. Thus the GATE input can be used to synchronize the Counter

After writing a Control Word and initial count, the Counter will be loaded on the next CLK pulse. This allows the Counter to be synchronized by software also.

Writing a new count while counting does not affect the current counting sequence. If a trigger is received after writing a new count but before the end of the current half-cycle of the square wave, the Counter will be loaded with the new count on the next CLK pulse and counting will continue from the new count. Otherwise, the new counter will be loaded at the end of the current half-cycle.

Mode 3 is implemented as follows:

Even counts: OUT is initially high. The initial count is loaded on one CLK pulse and then is decremented by two on succeeding CLK pulses. When the count expires OUT changes value and the Counter is reloaded with the initial count. The above process is repeated indefinitely.

Odd counts: OUT is initially high. The initial count minus one (an even number) is loaded on one CLK pulse and then is decremented by two on succeeding CLK pulses. One CLK pulse after the count expires. OUT goes low and the Counter is reloaded with the initial count minus one. Succeeding CLK pulses decrement the count by two. When the count expires, OUT goes high again and the Counter is reloaded with the initial count minus one. The above process is repeated indefinitely. So for odd counts, OUT will be high for  $(N+1)/2$  counts and low for  $(N-1)/2$  counts.

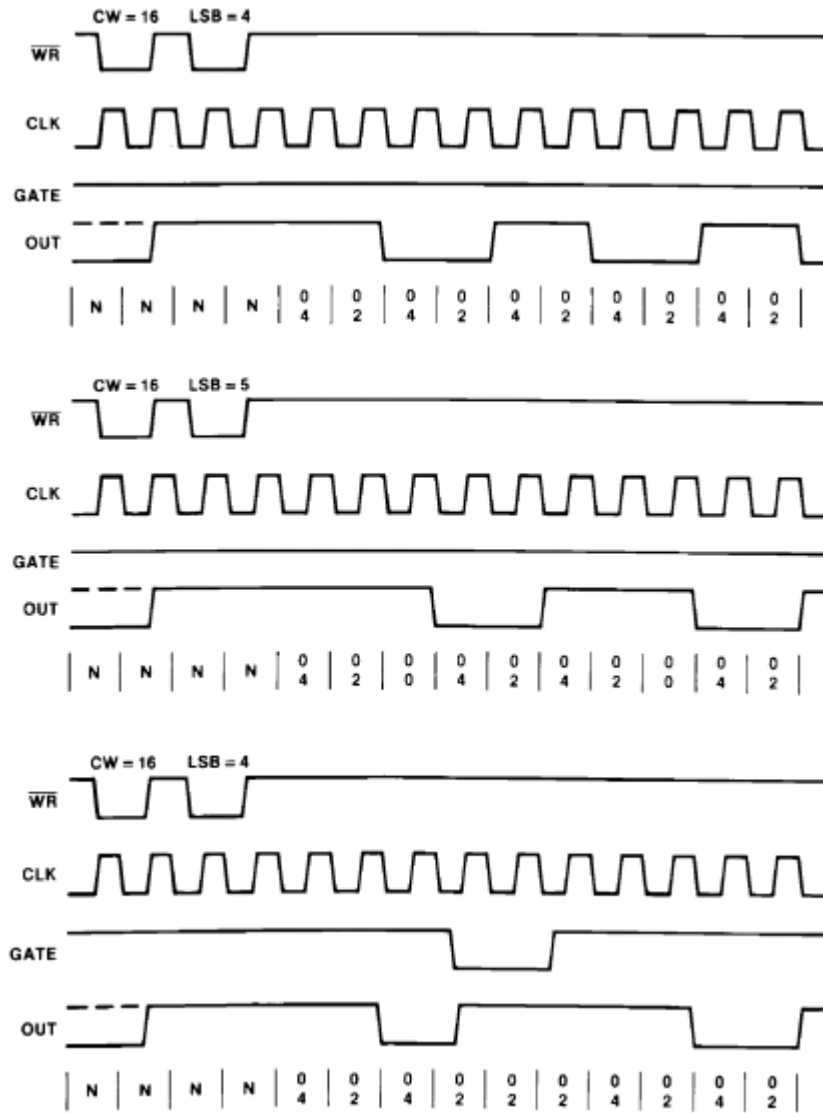


Figure 5.4 Mode 3

Note: A GATE transition should not occur one clock prior to terminal count.

**MODE 4 Software triggered strobe**

OUT will be initially high. When the initial count expires, OUT will go low for one CLK pulse and then go high again. The counting sequence is “triggered” by writing the initial count.

GATE=1 enables counting; GATE=0 disables counting. GATE has no effect on OUT.

After writing a Control Word and initial count, the Counter will be loaded on the next CLK pulse. This CLK pulse does not decrement the count, so for an initial count of N, OUT does not strobe low until N+1 CLK pulses after the initial count is written.

If a new count is written during counting, it will be loaded on the next CLK pulse and counting will continue from the new count. If a two-byte count is written, the following happens:

- 1) Writing the first byte has no effect on counting.
- 2) Writing the second byte allows the new count to be loaded on the next CLK pulse.

This allows the sequence to be ‘retriggered’ by software. OUT strobe low N+1 CLK pulses after the new count of N is written.

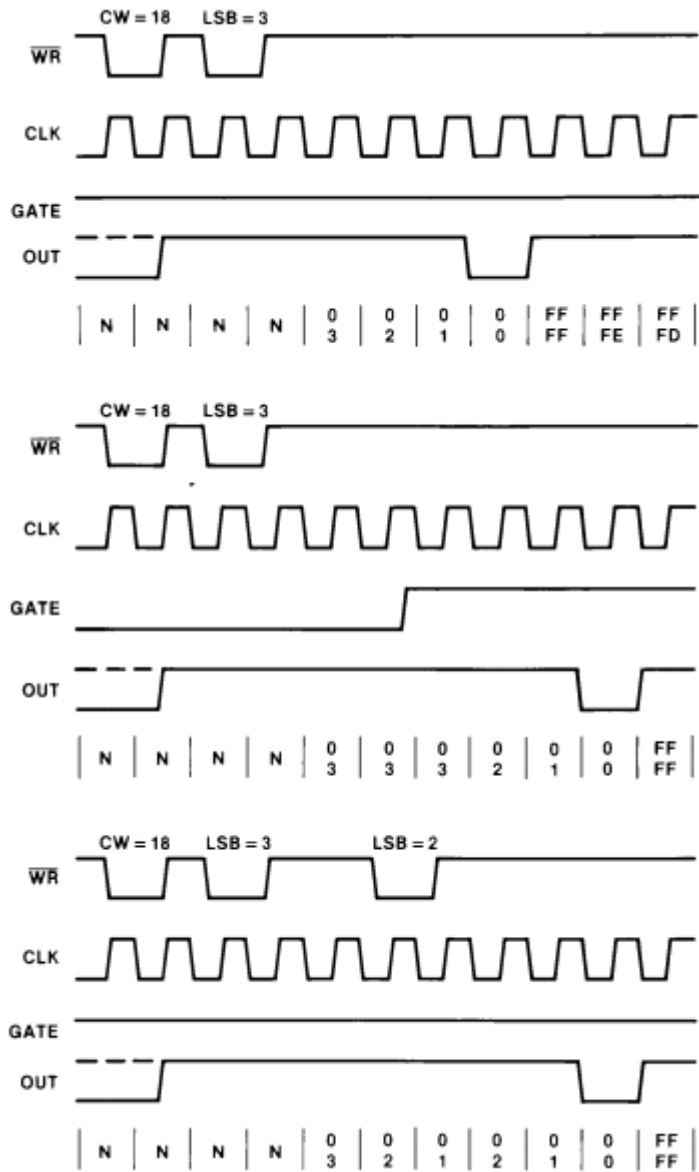


Figure 5.5 Mode 4

**MODE 5 Hardware triggered strobe**

OUT will initially be high. Counting is triggered by a rising edge of GATE. When the initial count has expired, OUT will go low for one CLK pulse and then go high again.

After writing the Control Word and initial count, the counter will not be loaded until the CLK pulse after a trigger. This CLK pulse does not decrement the count, so for an initial count of N, OUT does not strobe low until N+ 1 pulse after a trigger.

A trigger results in the Counter being loaded with the initial count on the next CLK pulse. The counting sequence is retriggerable. OUT will not strobe low for N+1 CLK pulses after any trigger. GATE has no effect on OUT.



If a new count is written during counting, the current counting sequence will not be affected. If a trigger occurs after the new count is written but before the current count expires, the Counter will be loaded with the new count on the next CLK pulse and counting will continue from there.

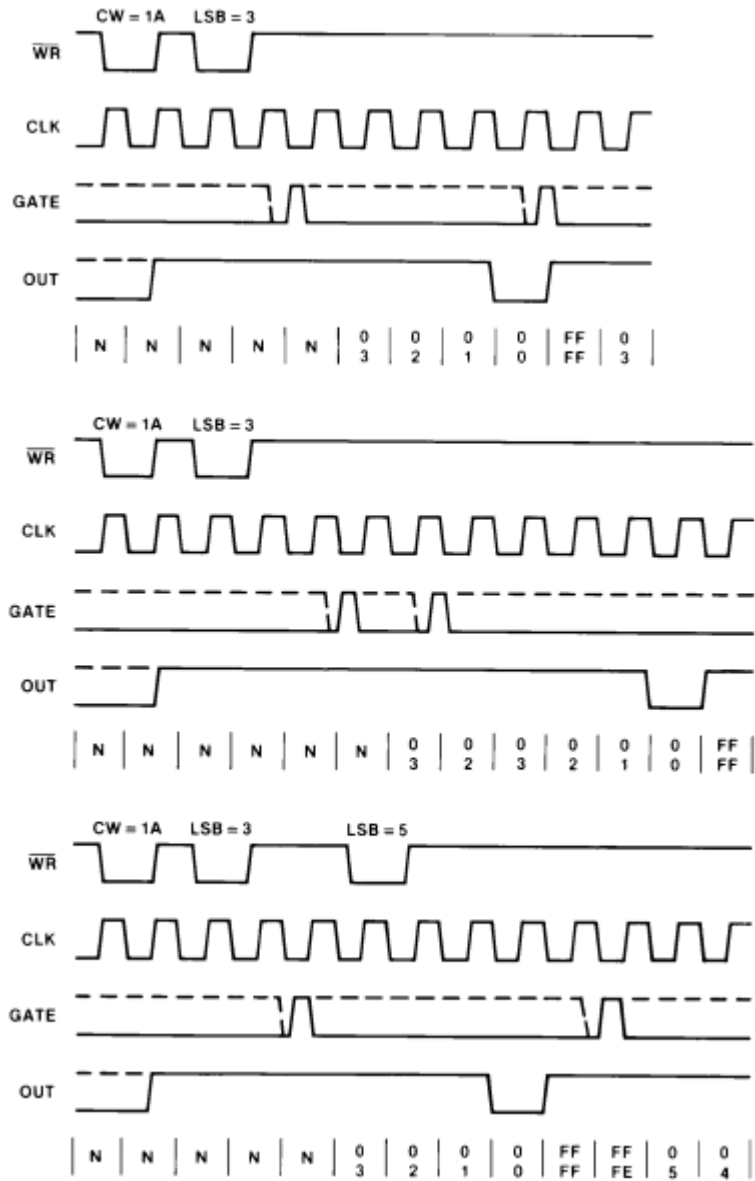


Figure 5.6 Mode 5

## ***Chapter 6 Notes, Calibration and Warranty Policy***

### **6.1 Notes**

In our products' packing, user can find a user manual, a USB5841 module and a quality guarantee card. Users must keep quality guarantee card carefully, if the products have some problems and need repairing, please send products together with quality guarantee card to ART, we will provide good after-sale service and solve the problem as quickly as we can.

When using USB5841, in order to prevent the IC (chip) from electrostatic harm, please do not touch IC (chip) in the front panel of USB5841 module.

### **6.2 Warranty Policy**

Thank you for choosing ART. To understand your rights and enjoy all the after-sales services we offer, please read the following carefully.

1. Before using ART's products please read the user manual and follow the instructions exactly. When sending in damaged products for repair, please attach an RMA application form which can be downloaded from: [www.art-control.com](http://www.art-control.com).
2. All ART products come with a limited two-year warranty:
  - The warranty period starts on the day the product is shipped from ART's factory
  - For products containing storage devices (hard drives, flash cards, etc.), please back up your data before sending them for repair. ART is not responsible for any loss of data.
  - Please ensure the use of properly licensed software with our systems. ART does not condone the use of pirated software and will not service systems using such software. ART will not be held legally responsible for products shipped with unlicensed software installed by the user.
3. Our repair service is not covered by ART's guarantee in the following situations:
  - Damage caused by not following instructions in the User's Manual.
  - Damage caused by carelessness on the user's part during product transportation.
  - Damage caused by unsuitable storage environments (i.e. high temperatures, high humidity, or volatile chemicals).
  - Damage from improper repair by unauthorized ART technicians.
  - Products with altered and/or damaged serial numbers are not entitled to our service.
4. Customers are responsible for shipping costs to transport damaged products to our company or sales office.
5. To ensure the speed and quality of product repair, please download an RMA application form from our company website.

# Products Rapid Installation and Self-check

## Rapid Installation

Product-driven procedure is the operating system adaptive installation mode. After inserting the disc, you can select the appropriate board type on the pop-up interface, click the button **【driver installation】** ; or select CD-ROM drive in Resource Explorer, locate the product catalog and enter into the APP folder, and implement Setup.exe file. After the installation, pop-up CD-ROM, shut off your computer, insert the USB card. If it is a USB product, it can be directly inserted into the device. When the system prompts that it finds a new hardware, you do not specify a drive path, the operating system can automatically look up it from the system directory, and then you can complete the installation.

## Self-check

At this moment, there should be installation information of the installed device in the Device Manager (when the device does not work, you can check this item.). Open "Start -> Programs -> ART Demonstration Monitoring and Control System -> Corresponding Board -> Advanced Testing Presentation System", the program is a standard testing procedure. Based on the specification of Pin definition, connect the signal acquisition data and test whether AD is normal or not. Connect the input pins to the corresponding output pins and use the testing procedure to test whether the switch is normal or not.

## Delete Wrong Installation

When you select the wrong drive, or viruses lead to driver error, you can carry out the following operations: In Resource Explorer, open CD-ROM drive, run Others-> SUPPORT-> USB.bat procedures, and delete the hardware information that relevant to our boards, and then carry out the process of section I all over again, we can complete the new installation.