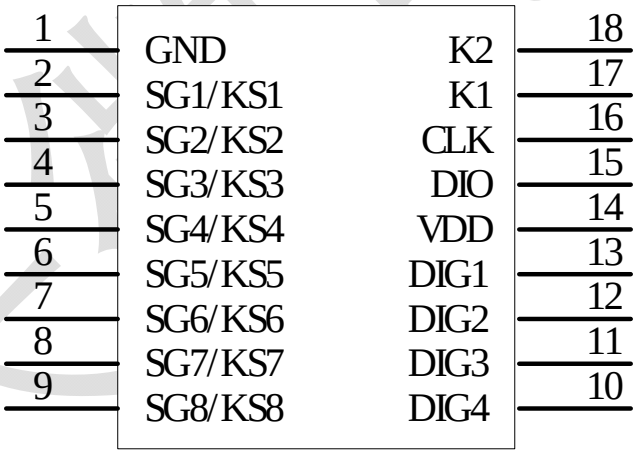
I. Overview

TM1636 is a special circuit for LED (light-emitting diode) driver control with keyboard scanning port. It integrates with different circuits such as MCU digital port, data latch, LED high-voltage drive, keyboard scanning, etc. The product has good performance and reliable quality, and is mainly applied in display drive of Electromagnetic oven, microwave ovens, and small household electrical appliance display driver. The packing is DIP18

II. Features

- **Low power consumption CMOS workmanship**
- **Display mode**（8segment×4positions）
- **Key scanning**（2×8bit）
- **Luminance adjustment circuit (8-level adjustable duty cycle)**
- **Serial port(CLK,DIO)**
- **Oscillation mode: built-in RC oscillation**（450KHz±5%）
- **Built-in power-on reset circuit**
- **Automatic blanking circuit**
- Packing：DIP18

III. Pin definitions:



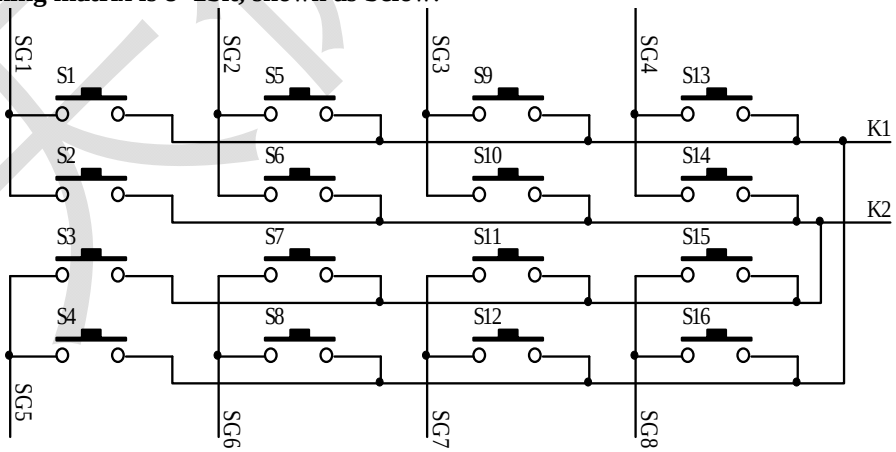
III. Pin definitions

Sign	Name	PIN number	Description
DIO	Data input / output	15	Serial data input / output, input data at SLCK low level, high level is in SCLK transmission, each transmission of a byte chip will be in the ninth clock generating a ACK
CLK	Data input	16	On the rising edge of the input / output data
K1~K2	Key scan data input	17-18	The input of the feet of the data in the display cycle after the end of the latch
SG1~SG8	Output (section)	2-9	Segment output (also used as a key scanning), N tube with open drain output
GRID4~GRID1	Output	10-13	Bit output, P tube with open drain output
VDD	Logic power supply	14	5V±10%
GND	Logic ground	1	Grounding system

In the dry season or the dry environment, easy to produce a large number of electrostatic, electrostatic discharge may damage the integrated circuits, microelectronics that day to take all appropriate integrated circuit prevention measures, if the improper operation and welding, may cause ESD damage or sexual energy decrease, chip is not working properly。

VI. Key scanning and key scanning register

The key scanning matrix is 8×2bit, shown as below:



In the button is depressed, reading the key data are as follows:

	SG1	SG2	SG3	SG4	SG5	SG6	SG7	SG8

K1	1110_1111	0110_1111	1010_1111	0010_1111	1100_1111	0100_1111	1000_1111	0000_1111
K2	1111_0111	0111_0111	1011_0111	0011_0111	1101_0111	0101_0111	1001_0111	0001_0111

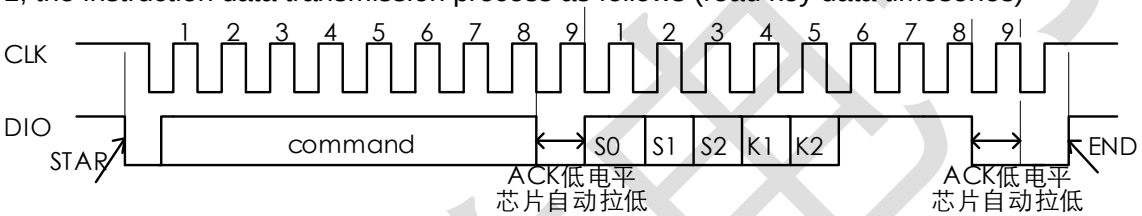
Note: in the absence of the button is pressed, a key reading data：1111_1111;

Interface description

Microprocessor data through two wire bus interface and TM1636 communications, in the input data when the CLK is in high level, the DIO signal must remain unchanged; only CLK the clock signal is low, the DIO signal can change. Data input start condition is CLK is in high level, the DIO changes from high to low; end condition is the CLK is higher, DIO from low level to high level.

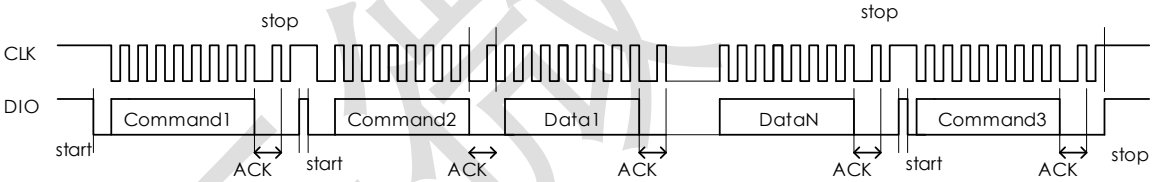
TM1636 data transmission with transponder signal ACK, when transmitting data correctly when, in eighth the falling edge of the clock, the internal chip generates a response signal ACK the DIO pin is pulled, in ninth after the release of DIO line clock.

1, the instruction data transmission process as follows (read key data timeseries)



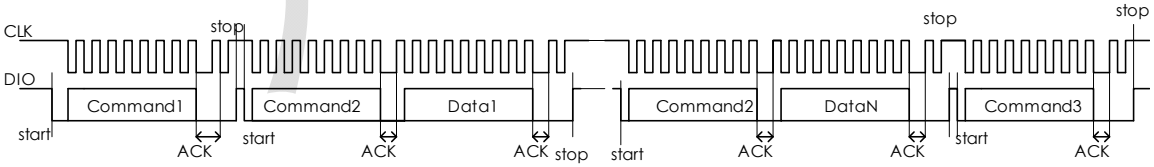
Command：Read key instructions; S0, S1, S2, K1, K2 consisting of key information coding, S0, S1, S2 for SG coding, K1, K2 K1 and K2 key coding.

2, write SRAM data address automatically add the 1 model



Command1：Setting data
Command2：Setting site
Data1~N：Display data transmission
Command3：Control display

3、Writing SRAM data fixed address mode



Command1：Setting data
Command2：Setting site
Data1~N：Display data transmission
Command3：Control display

Data command

Instructions for setting a display mode and LED drive state.

On the falling edge of STB by DIO after the input of the first byte of an instruction. After decoding, and the highest B7, B6 two bit to distinguish different instruction.

B7	B6	Command
0	1	**Data set**
1	0	**Display control command set**
1	1	**Address command set**

If the instruction or data transmission when the STB is set to a high level, the serial communication is initialized, and is transmitted from the instruction or data is invalid (transmitted before the instruction or data to maintain effective).

1.data set

The command is used to set the data write and read, B1 and B0 bit is set to 01 or 11 is not allowed. MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Function	Description
0	1	Unrelated items, fill 0				0	0	Data read and write mode setting	Write data to the display register
0	1					1	0		Read the key scan data
0	1				0			Address Increment mode setting	Automatic address increment
0	1				1				Fixed address
0	1			0				Test mode setting (internal use)	Normal mode
0	1			1					Test mode

2, IP address setting

MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Display address
1	1	Unrelated items, fill 0		0	0	0	0	00H
1	1			0	0	0	1	01H
1	1			0	0	1	0	02H
1	1			0	0	1	1	03H

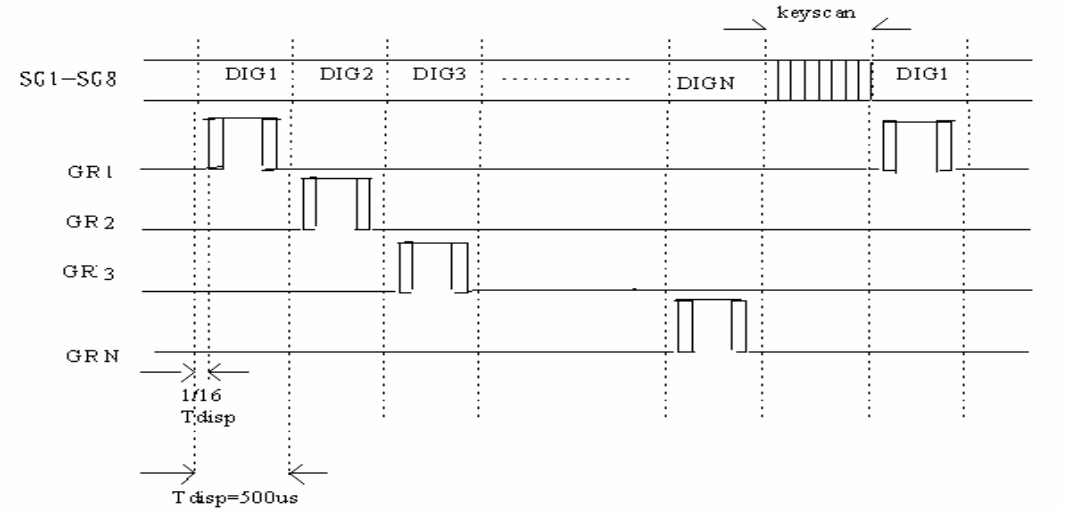
The command is used to set the display register address; if the address is set to 0C4H or higher, the data is ignored, until the effective address is set; when the power is on, the default is set to 00H address.

3, display control

MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Function	Description
1	0	Unrelated items, fill 0			0	0	0	Extinction number set	Set pulse width for the 1/16
1	0				0	0	1		Set pulse width for the 2/16
1	0				0	1	0		Set pulse width for the 4/16
1	0				0	1	1		Set pulse width for the 10/16
1	0				1	0	0		Set pulse width for the 11/16
1	0				1	0	1		Set pulse width for the 12/16
1	0				1	1	0		Set pulse width for the 13/16
1	0				1	1	1		Set pulse width for the 14/16
1	0			0				Display switch is set	OFF
1	0			1					ON

Display and key scan cycle



Reference program

```
/*
 * Copyright information:      SHENZHEN TITAN MICRO ELECTRONICS COP,.LT
 * File name:          TM1636
 * SCM model:    AT89S52
 * Development environment:       Keil uVision3
 * Crystal vibration frequency:       11.0592M
 * Function:      The TM1636 all display register address all write data 0xff, and a display, and then read the key value。
 */
#include<reg52.h>
#include<intrins.h>
// Define port
sbit clk = P1^2;
sbit dio = P1^1;

///=======================================
void Delay_us(unsigned int i)       //nus Time delay
{
        for(;i>0;i--)
        _nop_();
}

///=======================================
void I2CStart(void)                 //1636 Start
{
        clk = 1;
        dio = 1;
        Delay_us(2);
        dio = 0;
}

///=============================================
void I2Cask(void)                     //1636 Answer
{
      clk = 0;
       Delay _us(5);                 // In eighth after the falling edge of the clock delay 5us, began to determine ACK signal
        while(dio);
          clk = 1;
       Delay_us(2);
          clk=0;
}
```

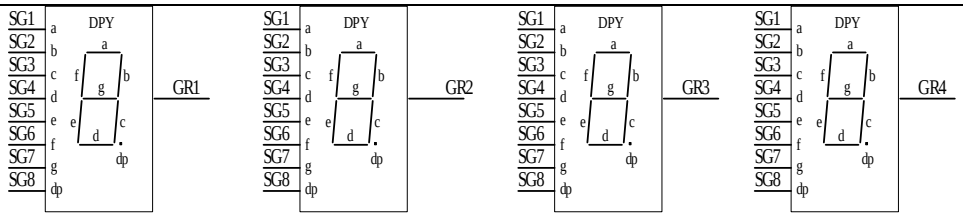
```
///=======================================
void I2CStop(void)                    // 1636 Stop
{
        clk = 0;
        Delay_us(2);
        dio = 0;
        Delay_us(2);
        clk = 1;
        Delay_us(2);
        dio = 1;
}

///=======================================
void I2CWrByte(unsigned char oneByte)    // Write a byte
{
    unsigned char i;
      for(i=0;i<8;i++)
      {   clk = 0;
          if(oneByte&0x01)          // Low in the front
          {
              dio = 1;
          }
           else
          {
              dio = 0;
          }
          Delay_us(3);
         oneByte=oneByte>>1;
         clk=1;
         Delay_us(3);
      }
}

///-----------------------------------------------
unsigned char ScanKey(void)                  // Read key
{
    unsigned char rekey,rkey,i;
      I2CStart();
      I2CWrByte(0x42);                        // Read key command
      I2Cask();
      dio=1;                                  // Read key before pulling the high data line
      for(i=0;i<8;i++)                       // From the low began to read
      {   clk=0;
```

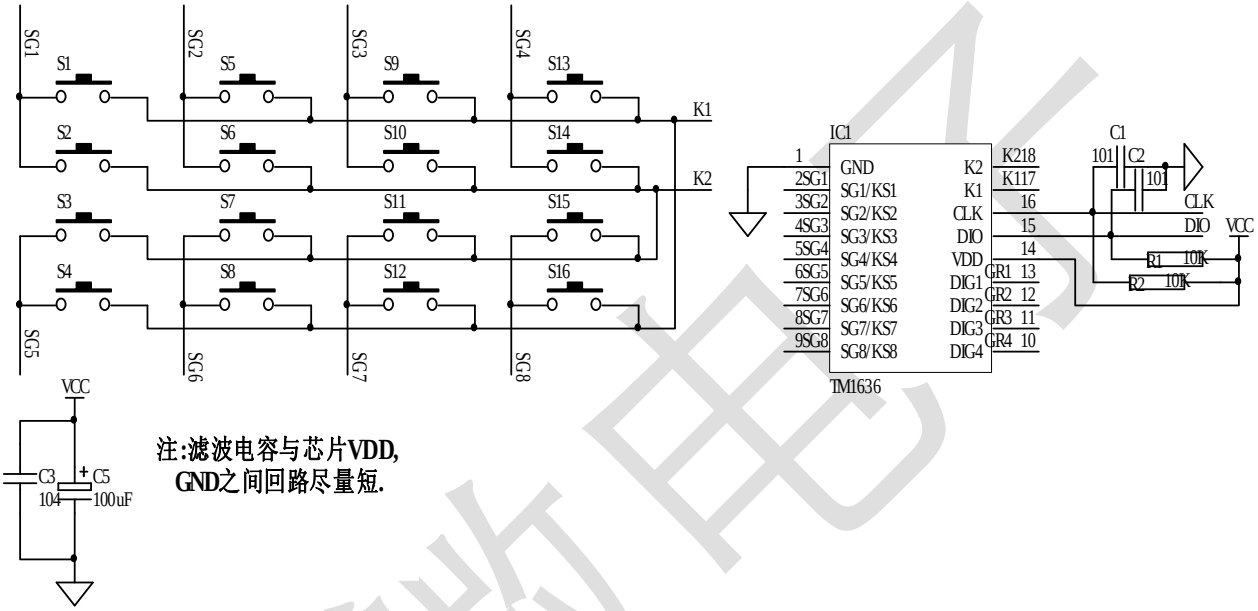
```
                rekey=rekey>>1;
                Delay_us(30);
                clk=1;
                if(dio)
                {
                    rekey=rekey|0x80;
                }
                else
                {
                    rekey=rekey|0x00;
                }
                Delay_us(30);
            }
            I2Cask();
            I2CStop();
        return (rekey);
    }

    ///=============================================
    void SmgDisplay(void)                    // Write display register
    {
        unsigned char i;
        I2CStart();
        I2CWrByte(0x40);                     // The 40H address automatically add the 1 model,
fixed 44H address mode, the program uses from 1 modelI2Cask();
        I2CStop();
        I2CStart();
        I2CWrByte(0xc0);                     // address,
        I2Cask();

          for(i=0;i<4;i++)                   // Address from, do not have to always write the
address
            {
                I2CWrByte(0xff);             // Send data
                I2Cask();
        }
          I2CStop();

          I2CStart();
          I2CWrByte(0x8f);                   // Open display, maximum brightness
          I2Cask();
          I2CStop();
    }
```

```
///==========================================
void init()                                  // Initialization subroutine
{
    //…
}

///==========================================
void main(void)
{
      unsigned char keydate;
      init();                                // Initialization
      SmgDisplay();                          // Write register and display
      while(1)
      {
            keydate=Scankey();               // Read the key value, read the key value is not dealt with。
      }
}
//===========end================================
```

Hardware connection diagram

Circuit diagram of the digital control for a total of Yang digital tube





注:滤波电容与芯片VDD, GND之间回路尽量短.

Electrical parameters

1、Limit parameter (Ta = 25℃, Vss = 0 V)

parameter	Symbol	range	unit
Logic power supply voltage	VDD	-0.5 ～+7.0	V
Logic power supply voltage	VI1	-0.5 ～ VDD + 0.5	V
LED Seg Driver output current	IO1	-50	mA
LED DIG Driver output current	IO2	+200	mA
Power loss	PD	400	mW

Working temperature	Topt	-40 ～ +85	℃
Storage temperature	Tstg	-65 ～+150	℃

2、**Normal operating range**（Ta = -40～+85℃，Vss = 0 V）

parameter	Symbol	MIN	Typical	MAX	Unit	condition
Logic power supply voltage	VDD		5		V	-
High level input voltage	VIH	0.7 VDD	-	VDD	V	-
Low level input voltage	VIL	0	-	0.3 VDD	V	-

3、**Electrical characteristics**（Ta = -40～+85℃，VDD = 4.5 ～ 5.5 V， Vss = 0 V）

parameter	Symbol	MIN	Typical	MAX	Unit	condition
High level output current	Ioh1	-20	-25	-40	mA	Seg1~Seg11，Vo = vdd-2V
	Ioh2	-20	-30	-50	mA	Seg1~Seg11，Vo = vdd-3V
Low level output current	IOL1	80	140	-	mA	DIG1~DIG4 Vo=0.3V
Low level output current	Idout	4	-	-	mA	VO = 0.4V，dout
High level output current tolerance	Itolsg	-	-	5	%	VO = VDD － 3V，Seg1～Seg11
The output pulldown resistor	RL		10		KΩ	K1~K2
Input current	II	-	-	±1	μA	VI = VDD / VSS
High level input voltage	VIH	0.7 VDD	-		V	CLK，DIN
Low level input voltage	VIL	-	-	0.3 VDD	V	CLK，DIN
Lagging voltage	VH	-	0.35	-	V	CLK，DIN
Dynamic current loss	IDDdyn	-	-	5	mA	No load, show off

4、**Switching characteristics**（Ta = -40～+85℃，VDD = 4.5 ～ 5.5 V）

parameter	Symbol	MIN	Typical	MAX	Unit	Condition	
Oscillation frequency	fosc	-	450	-	KHz		
Propagation delay time	tPLZ	-	-	300	ns	CLK → DIO CL = 15pF, RL = 10KΩ	
	tPZL	-	-	100	ns		
Rise time	TTZH 1	-	-	2	μs	CL = 300p F	Seg1～Seg11
	TTZH 2	-	-	0.5	μs		DIG1～DIG4
Fall time	TTHZ	-	-	120	μs	CL = 300pF，Segn，Gridn	
Maximum clock frequency	Fmax	1	-	-	MHz	占空比50%	
Input capacitance	CI	-	-	15	pF	-	

Timing characteristics（Ta = -40 ～+85℃，VDD = 4.5 ～ 5.5 V）

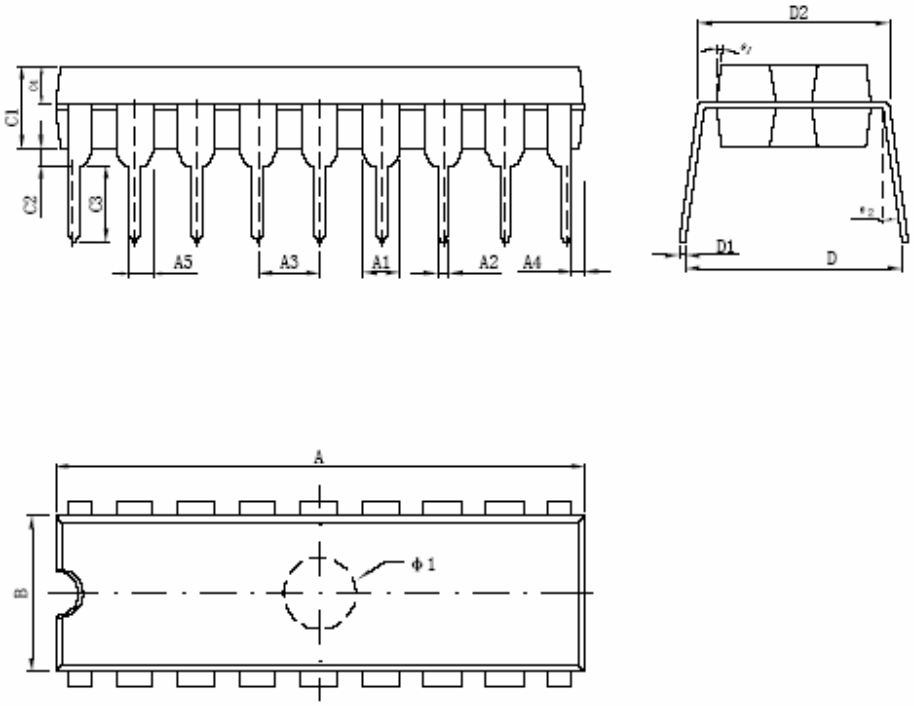
parameter	Symbol	MIN	Typical	MAX	Unit	condition
Clock pulse width	PWCLK	400	-	-	ns	-
Pulse width	PWSTB	1	-	-	μs	-
Data setup time	tSETUP	100	-	-	ns	-
Data hold time	tHOLD	100	-	-	ns	-

Wait time	tWAIT	1	-	-	μs	CLK↑→CLK↓

IC Packing picture

DIP18

尺寸 / 标注	最 小 (mm)	最 大 (mm)	尺寸 / 标注	最 小 (mm)	最 大 (mm)
A	21.90	22.10	C3	3.4	3.6
A1	1.40TYP		C4	1.58TYP	
A2	0.43	0.57	D	8.10	8.60
A3	2.54TYP		D1	0.20	0.35
A4	0.59TYP		D2	7.62	7.87
A5	0.95TYP		Φ1	3.0TYP	
B	6.3	6.5	θ1	8° TYP	
C1	3.4	3.6	θ2	5° TYP	
C2	0.6	0.8			



Revision description

Edition	Revision time	Revision Description

V1.0	2010-05-06	初版发行
Ver1.1	2012-08-16	1、修改排版格式 2、添加参考例程 3、修改关于 ACK 信号的描述