

Driving Matrix LEDs Using the HT1632 to Display an Animated Figure

D/N: HA0136E

Introduction

The HT1632 is a memory mapping type of LED display driver device. Its range of applications are large and can include digital clocks, thermometers, humidity meters, industrial instrument displays as well as many others.

The animated figure Demo Board uses an HT1632 to drive six 8×8 LED matrix panels to form a overall 24×16 LED matrix which is used to depict a walking person display effect.

The HT1632 has two display formats: 24 outbits/16 commons and 32 outbits/8 commons. This design uses the 24 outbits/16 common display format.

The animated figure uses 10 different screen display formats to create the walking person effect. Pressing the switch will initiate different walking effect types.

HT1632 Basic Characteristics

- Operating Voltage: 2.4V~5.5V
- 2 display types: 32 outbits/8 commons or 24 outbits/16 commons
- Internal RAM
 - if 32 outbits/8 commons are selected then RAM is 64x4 bits
 - if 24 outbits/16 commons are selected then RAM is 96x4 bits
- 16-level PWM brightness control
- Internal 256K RC oscillator
- Serial interface communication with the MCU
- Instruction and Data instruction communication with the MCU
- Common lines can select NMOS or PMOS open-drain output drive types

Hardware Block Diagram

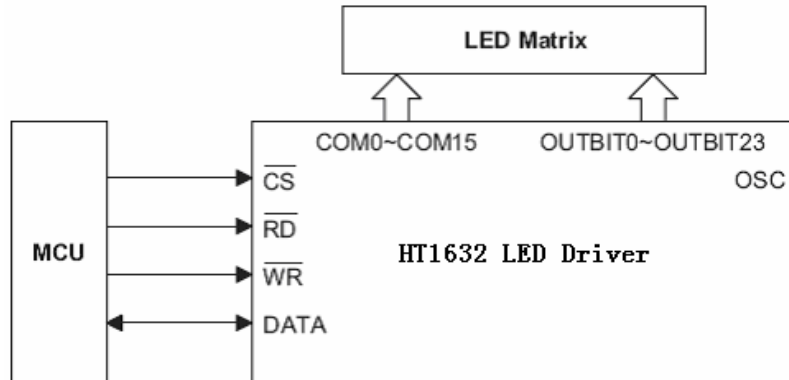


Figure 1

The main controller is the HT48R10A-1, which in turn controls the HT1632 LED driver device. The HT48R10A-1 uses an external 4MHz external RC oscillator while the HT1632 uses its internal 150kHz internal RC oscillator. The LED driver interface signals are the CS, WR and DATA lines, which correspond to the PA0, PA1 and PA2 lines on the HT48R10A-1. The switch is connected to pin PA.4.

Six 8x8 LED matrix panels together will form a 24x16 size display made up of two rows and 3 columns. The HT1632 uses the 24 outbits/16 common display format.

Hardware Circuit Description

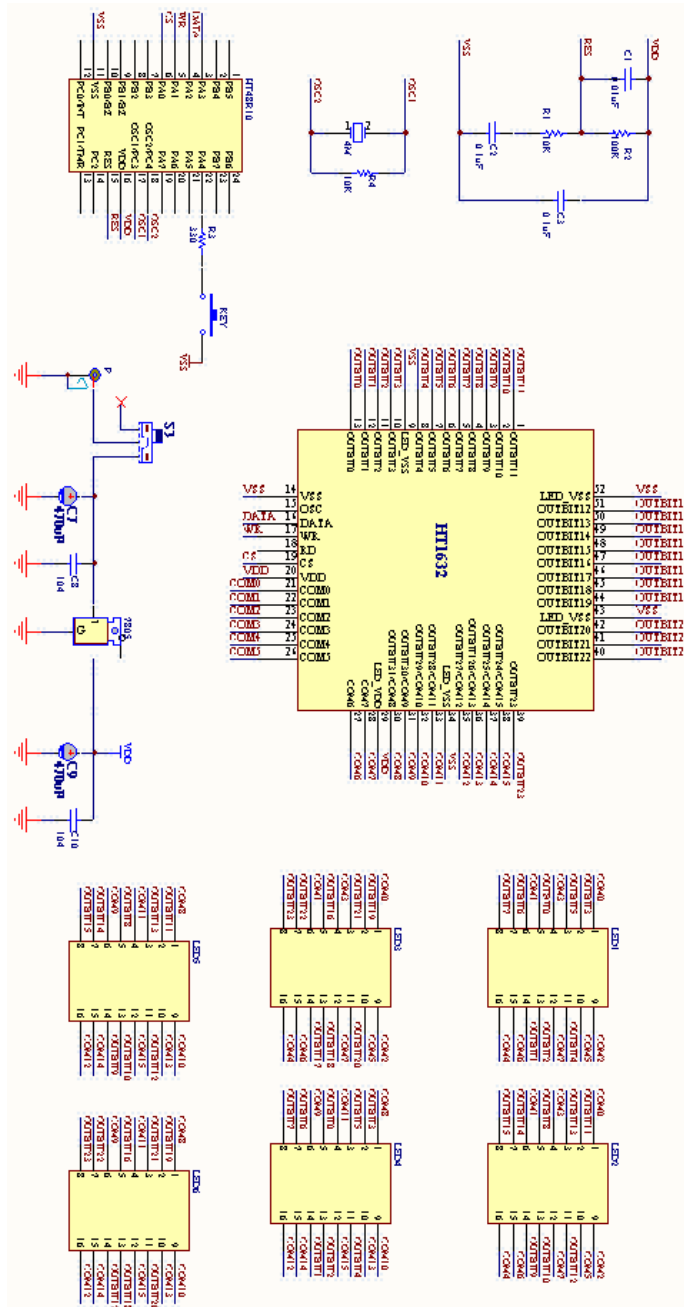


Figure 2

The power supply input is DC 9V which is regulated down to 5V using a 7805 regulator device. C7, C8, C9 and C10 are filter capacitors. The HT1632 uses its internal RC oscillator, which has a frequency of 150kHz.

The main controller is the HT48R10A-1, which uses an external 4MHz crystal. C1, C2, C3, R1 and R2 form the HT48R10A-1 reset circuit.

LED matrix internal structure:

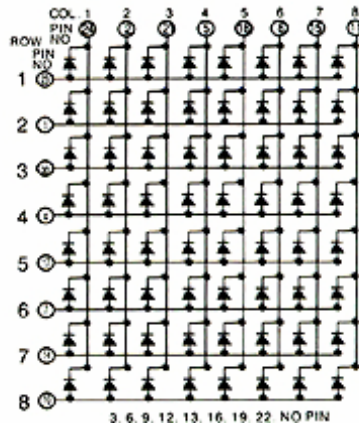


Figure 3

8x8 LED matrix pins are as follows:

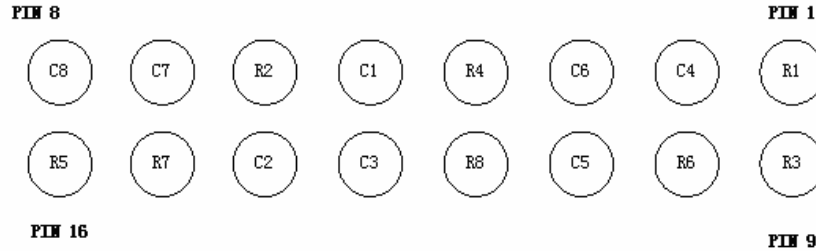


Figure 4
R represents Rows – C represents Columns
This figure is the LED front side.

LED layout principle:

The LED display uses the 24 outbits/16 commons mode, (2 rows and 3 columns). The columns are the HT1632 COM lines and the rows are the OUTBITS. See Figure 5.

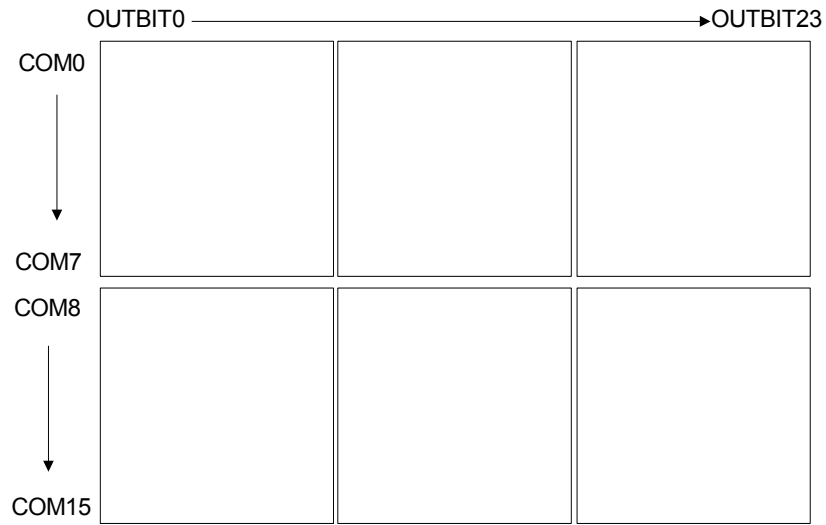


Figure 5

Pressing the switch changes the walking stype of the animated figure. The switch is connected to pin PA.4 on the HT48R10A-1.

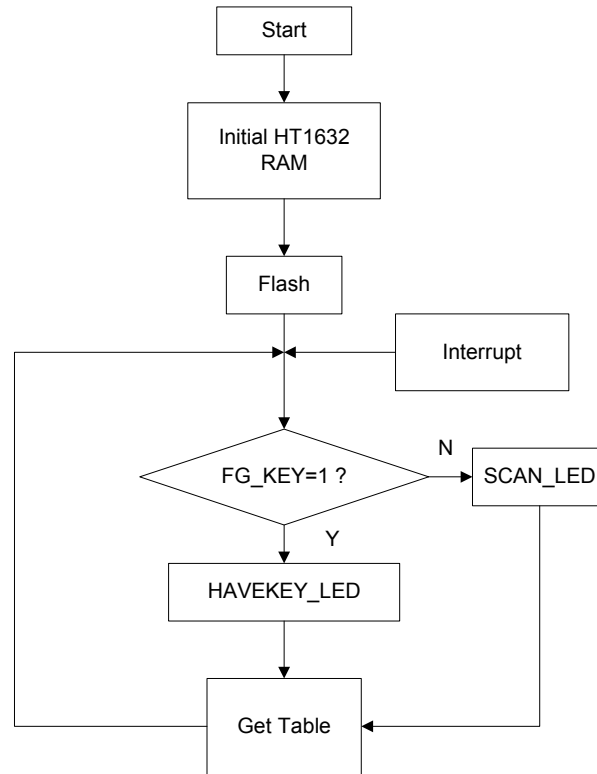
The animated figure starts from the right side of the first column and slowly walks out, continuously moving left until it extinguishes. Then another animated figure starts walking from the first column again in the same way. This cycle keeps repeating itself.

When the switch is pressed, the animated figure walks in its original location. When the switch is pressed again, the animated figure continuously walks forward.

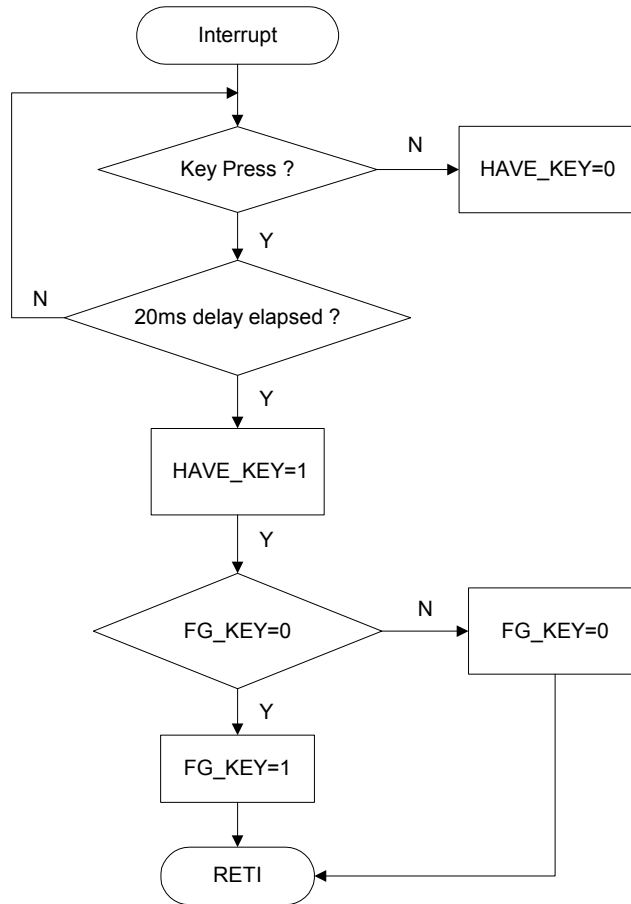
Software Design Description

Flowchart

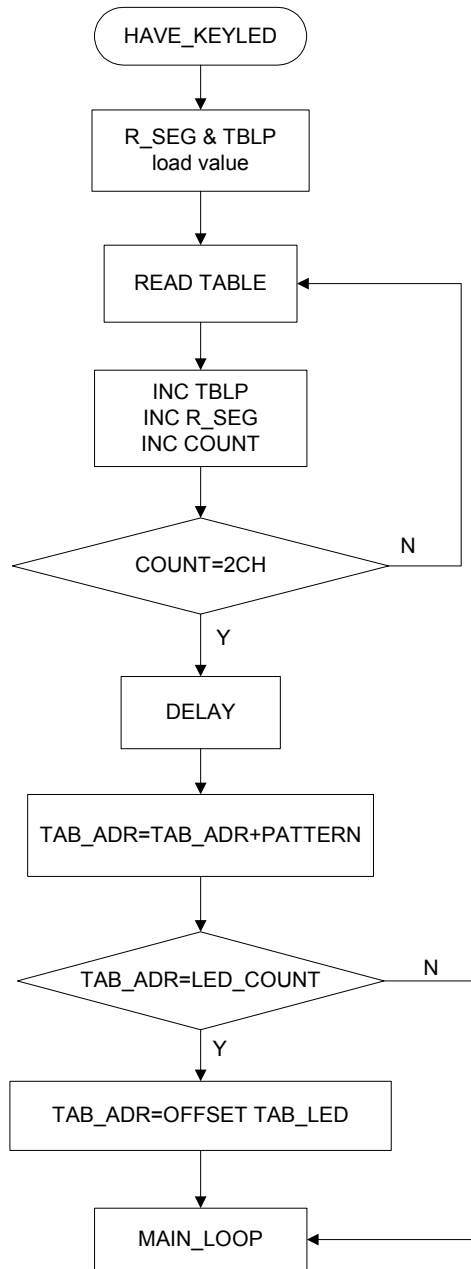
- Main



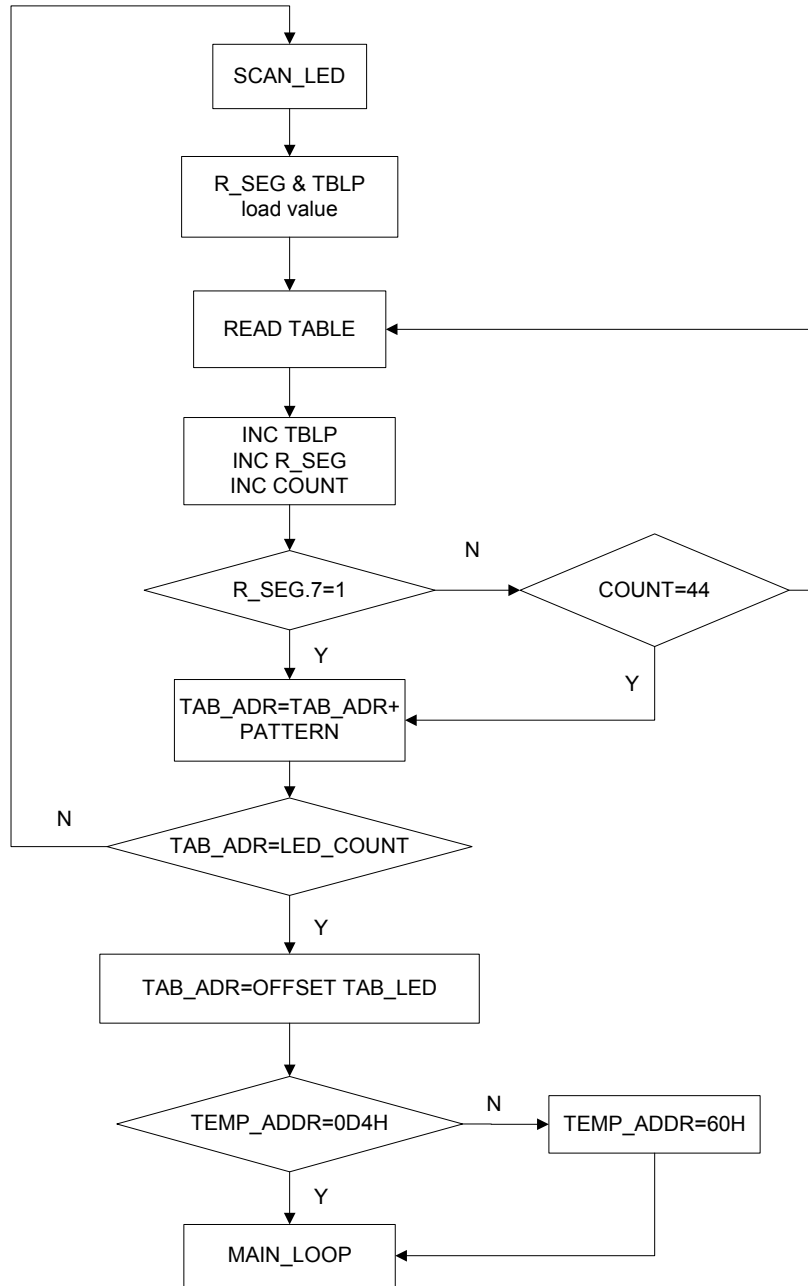
- Interrupt



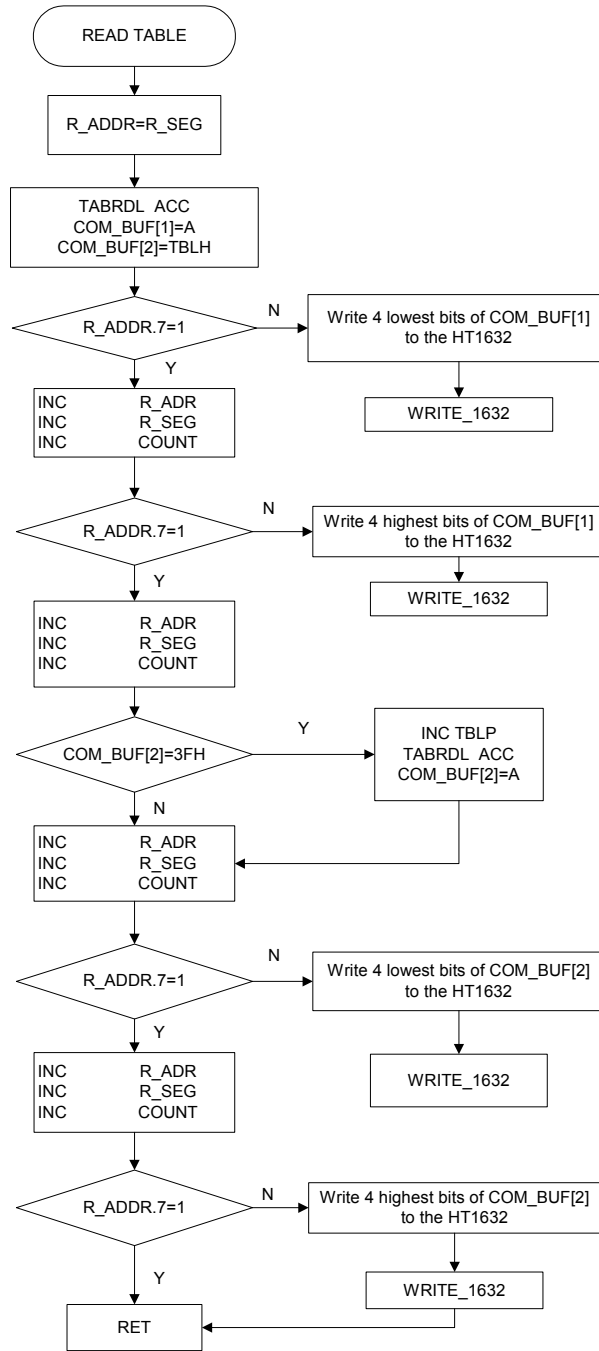
- HAVEKEY_LED



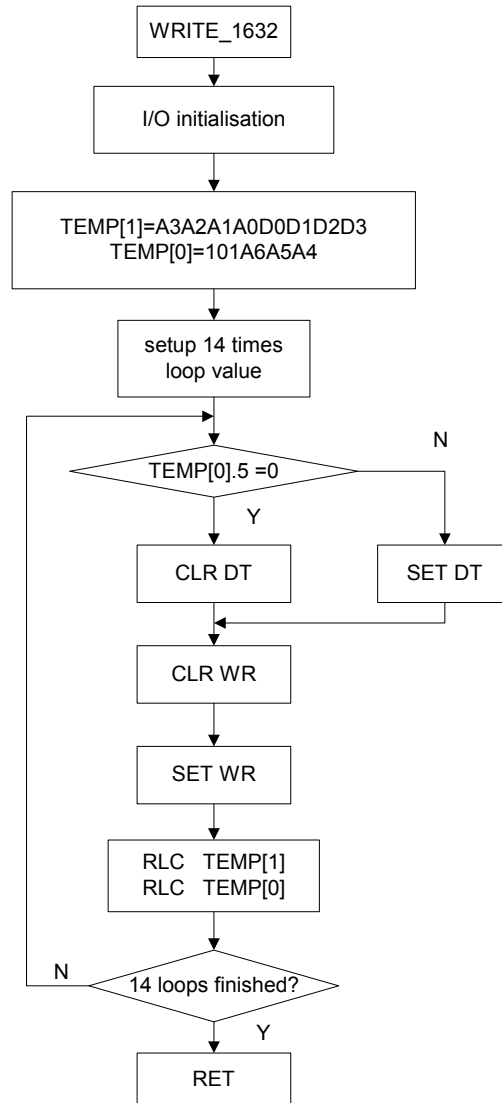
• SCAN_LED



- READ Table



- HT1632 Write



Software Design Description

This design uses 10 different types of screen displays to depict a walking person effect. For this reason the important point in the program is in the management of the transition between the different pictures and the gradual extinguishing of the displays. (consult the SCAN_LED flow). In the program, R_SEG is the HT1632 address register, R_ADDR is the HT1632 address, COUNT is the individual picture address and TEMP_ADDR records the address of the LED moving person.

MAIN: main program loop flowchart

SCAN_LED: no key press – person walking forward

HAVEKEY_LED: key press – person running on original location

INTERRUPT: determine if key is pressed – if not continuous cycle, if jump to HAVEKEY_LED

READ TABLE: Read data and process

When one action finishes, the picture will move to the left one position. When the animated figure arrives at the display edge, the read data is not written to the HT1632 until it disappears, and then data can be reloaded into TEMP_ADDR.

When data is read, R_SEG will increase by 3, COUNT will increase by 3, TBLP will increase by 1 or 2. TEMP_ADDR will reduce by 4.

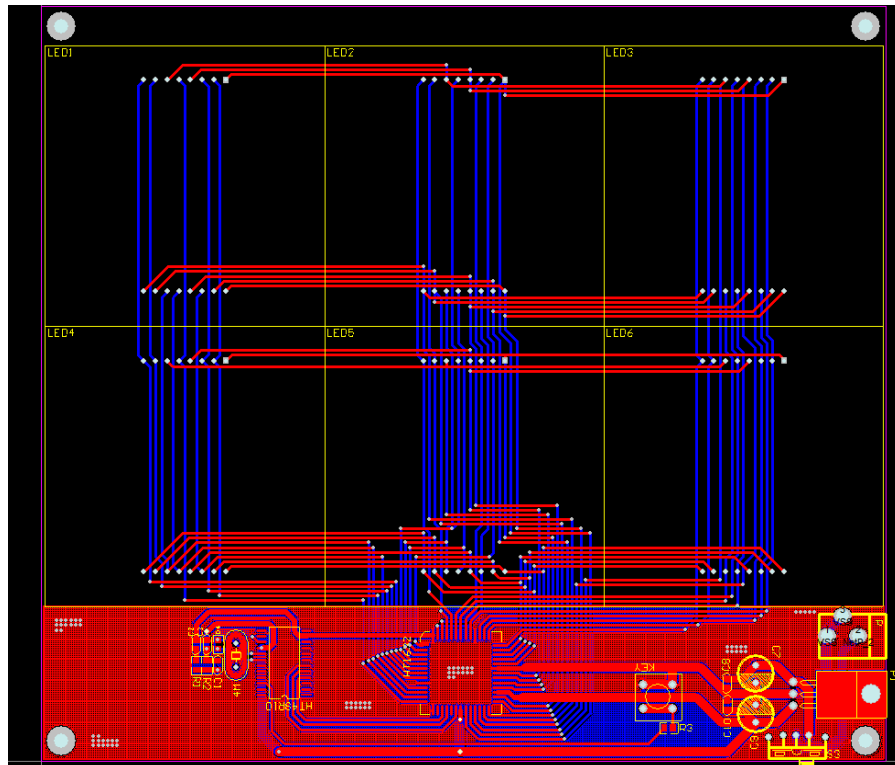
Because for some pictures a data read requires 16-bits and the HT48R10A-1 Program Memory has a capacity of 1024×14 bits, therefore before transmitting data, first determine if the highest data bits are equal to 3F. This indicates that the data is 16-bits. If this is the case, then 1 should be added to TBLP, if not then the data can be transmitted. Because data transmission to the HT1632 is 4 bits wide, each time data is read the high/low byte order needs to be determined.

After each animated picture has been displayed a delay is needed after another read is required. This is because, if the animated figure walking speed is changed then this can be achieved by adjusting this delay.

The animated figure original location walking style is achieved by: store TEMP_ADDR value and do not change, then write a table read value to R_ADDR. Then when the switch is pressed again TEMP_ADDR = TEMP_ADDR-4.

When writing to the HT1632, writing an HT1632 address requires a 14-bit data transmission. These 14-bits are composed of: 101 (3-bit write instruction), A6A5A4A3A2A1A0 (7-bit address) and D0D1D2D3 (4-bit data). The address is transmitted in a highest bits first format while the data is transmitted in a lower bits first format.

PCB Layout



BOM

Designator	LibRef	Description	Footprint	Comment
4M	XTAL	Crystal Oscillator	BCY-W2/D3.1	XTAL
C1	Cap	Capacitor	C	103
C2	Cap	Capacitor	C	104
C3	Cap	Capacitor	C	104
C7	CAPPOL		C4	470uF
C8	Cap	Capacitor	104	104
C9	CAPPOL		C4	470uF
C10	Cap	Capacitor	104	104
HT48R10A-1	Component_1			HT48R10A-1
HT1632	Component_1			
KEY	SW-PB	Switch	SPST-2	SW-PB
LED1	COMPONENT_2		LED	
LED2	COMPONENT_2		LED	
LED3	COMPONENT_2		LED	
LED4	COMPONENT_2		LED	
LED5	COMPONENT_2		LED	
LED6	COMPONENT_2		LED	
P	DCJACK		P	
P1	7805		7805	7805
R1	Res1	Resistor	R TEI	10K
R2	Res1	Resistor	R TEI	100K
R3	Res1	Resistor	AXIAL-0.3	330R
R4	Res Semi	Semiconductor Resistor	AXIAL-0.5	10K
S3	SW2WAY		PODONG	