Using the HT45FH3T for Active 3D Glasses

D/N: HA0315E

Introduction

With the continuous development of people's living standards, the requirements for audio-visual entertainment is increasing, thus more and more 3D videos, movies and games are being produced and along with this is the rising demand for 3D glasses. A new 3D technology, a combination of active shutter 3D technology and active shutter 3D glasses, is widely used in TV and projector applications and provides good imaging effects.

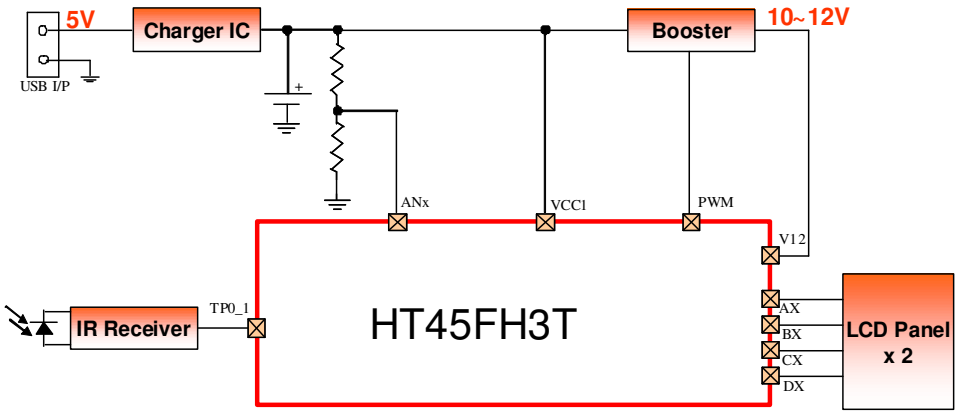
The Holtek HT45FH3T is especially designed for active 3D glasses development and this application sets out to show how it is used in such applications.

3D Glasses Functions

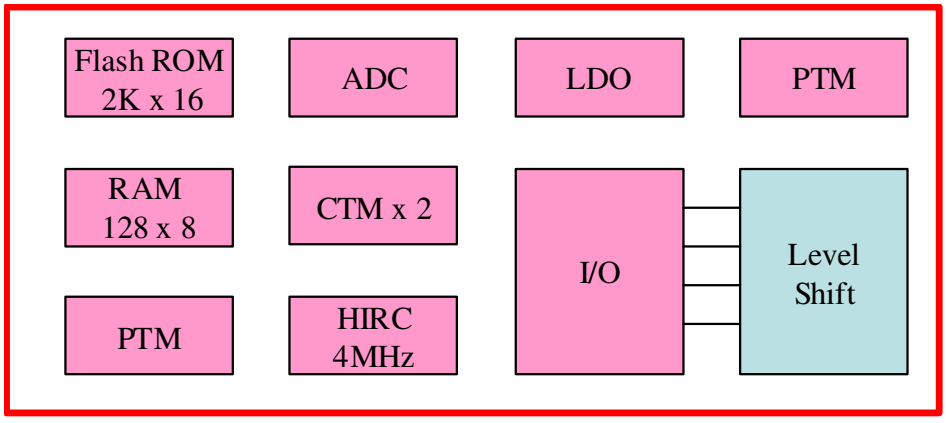
The main function of 3D glasses is to receive and decode the IR signals from the TV for 3D glasses control. Due to the high voltage driving requirement, a boost circuit is needed to increase the battery voltage to 10V~12V for 3D glasses driving. A pair of 3D glasses contains two lenses each for the left eye and right eye. As each lens needs two high driving voltages, thus four high driving voltages are needed. So each 3D glasses circuit contains four level shift circuits, which are used to increase the 3V MCU I/O output voltage to 10V~12V for the 3D glasses on/off control. In addition, each pair of 3D glasses needs an IR receiver circuit to receive external IR signals.

3D glasses normally use a battery power supply, which can be divided into two types. The first type is a chargeable lithium battery and the second type is a non-chargeable button battery. An additional lithium battery charging circuit is required when using the lithium battery.

3D Glasses Block Diagram



HT45FH3T 3D Glasses Block Diagram



HT45FH3T Active 3D Glasses Main Features

HT45FH3T Basic Features

- Operating Voltage : 2.2V ~ 5.5V @4MHz
- System Clock : HIRC 4MHz
- Multi-mode operation : NORMAL, SLOW, IDLE and SLEEP
- Flash Program Memory : 2K×16
- RAM Data Memory : 128 bytes
- 4-channel 12-bit ADC
- 10-bit CTM×2
- 10-bit PTM×1 -- provides PWM outputs
- 16-bit PTM×1 -- decodes IR input signals
- Over Voltage Protection function
- Level shift×4
- 3V LDO×1

Note: 1. The HT45FH3T system clock can be up to 4MHz.

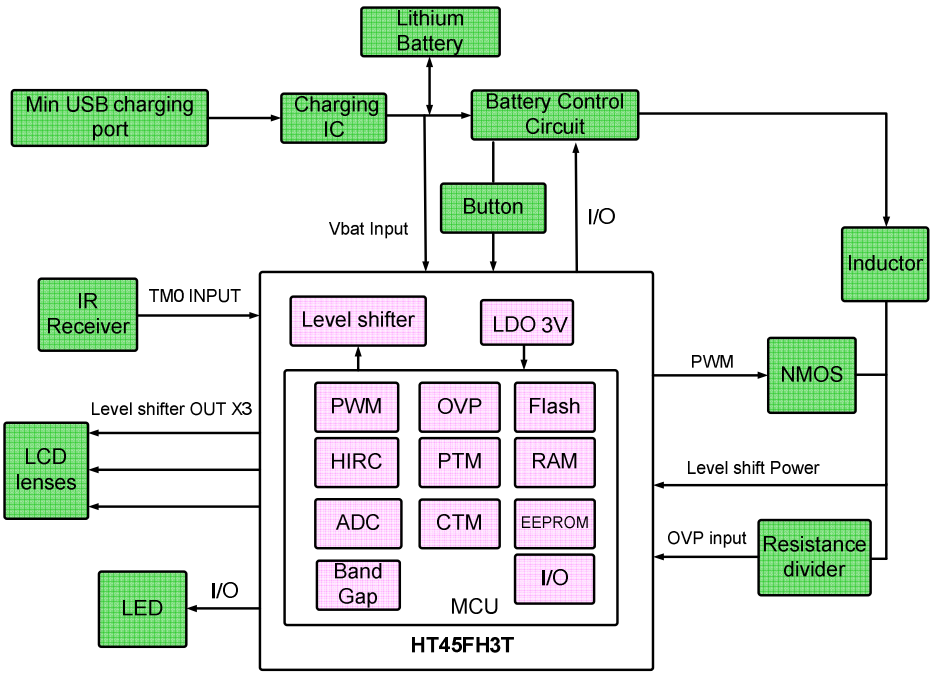
2. The HT45FH3T-1 system clock can be up to 8MHz.

HT45FH3T 3D Glasses Main Features

- Uses lithium battery : 100mAh
- Charging
  - Charging stand : USB Mini-B type ; input voltage : 5V
  - Use 100mA constant current for charging
- Use 3-Line controlled LCD lenses
- Provides a battery charging indicator LED (Y) and a low voltage indicator LED (R)
- Provides a button for glasses on/off control
- Operating current: about 680μA
- Three-stage power saving mode
  - First stage power saving mode average current: 280μA
  - Second stage power saving mode average current: 180μA
  - Third stage power saving mode: self-power off
- Use nVIDIA 3D VISION Protocol for IR

Hardware Block Diagram

Hardware Block Diagram

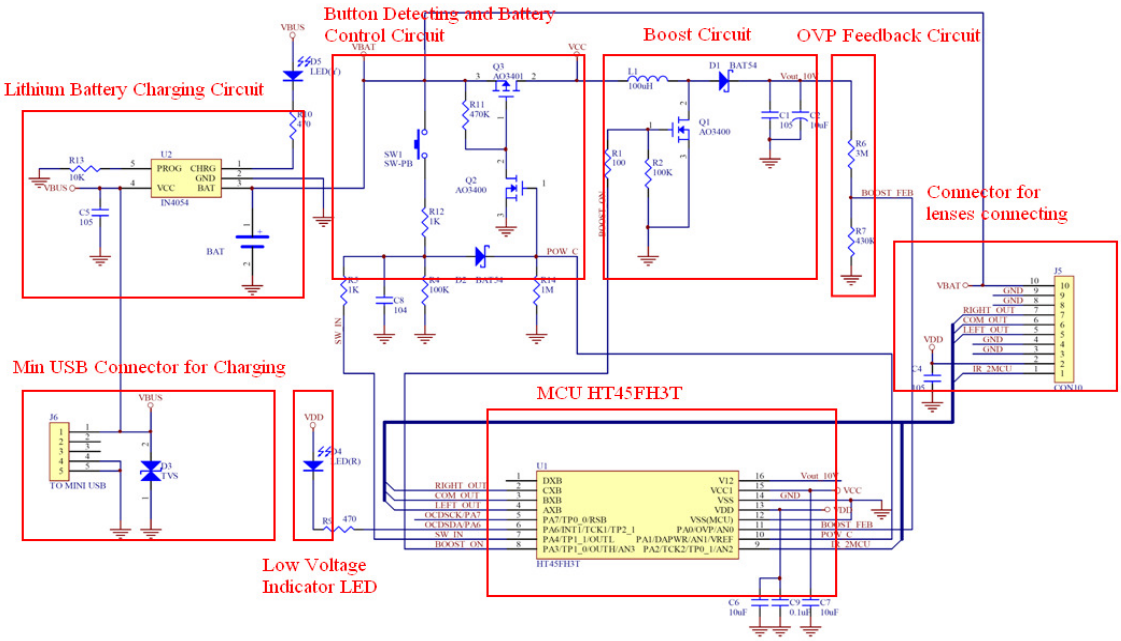


Hardware Block Diagram Functional Description

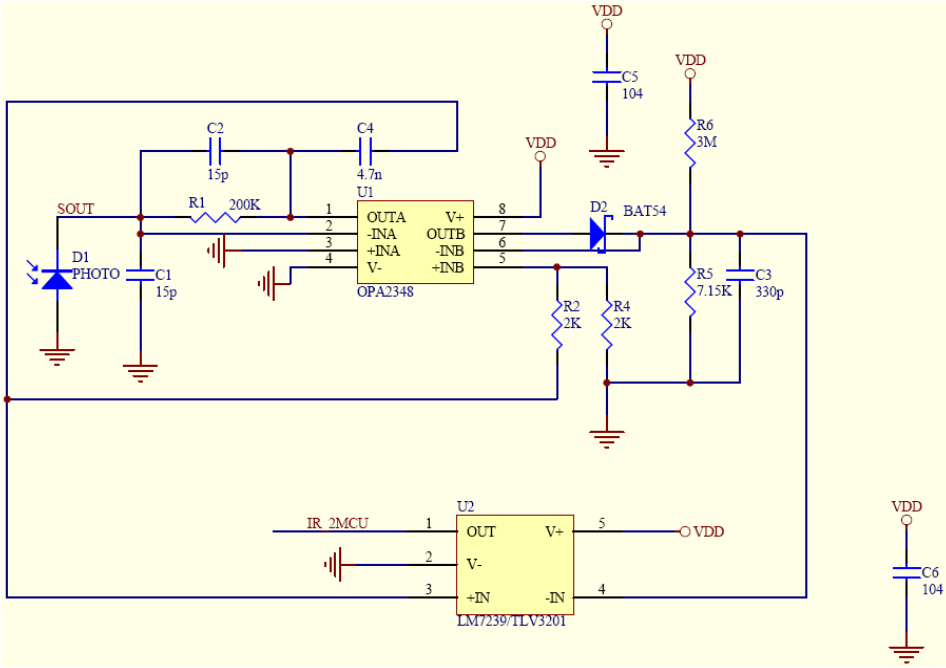
- Main control IC : HT45FH3T-1 -- system clock : 8MHz
- Main USB charging port
  This port can be connected to a computer USB interface or an external power adapter for lithium battery charging.
- Charging IC
  Use 100mA constant current for lithium battery charging, during which the yellow LED lights up.
- Inductor
  Used to boost the battery voltage to the LCD lenses switch voltage.
- N-MOS
  Used for inductor booster control.
- Lithium battery
  A lithium battery with a capacity of 100mAh.
- Battery control circuit
  Used for the third stage power saving mode: self-power off.
- Button
  For user manual power on/off.
- LED indicator
  Used for low voltage indicating.
- Resistance divider
  Used for booster feedback control.
- IR receiver
  Receives the IR signals and converts them into digital signals.
- LCD lenses
  Works along with the IR signal for left and right lens on/off control.

Hardware Circuit and Description

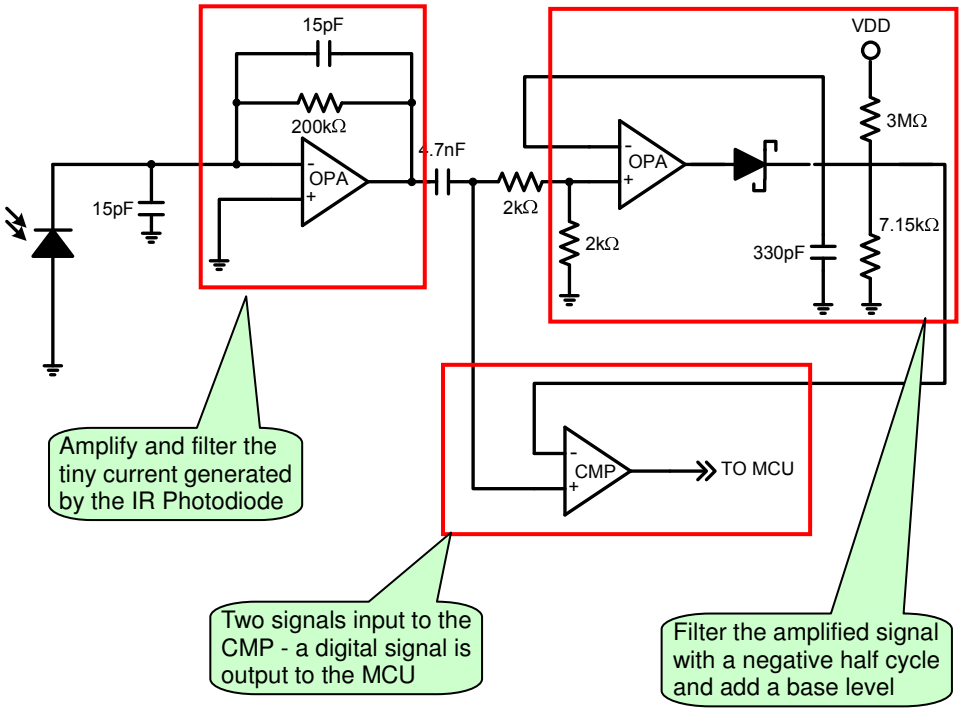
Main Board Circuit



IR Receiver Circuit



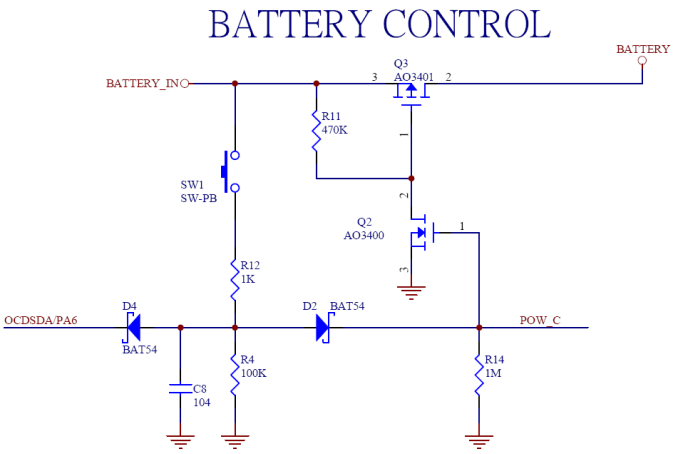
The schematic is shown below:



Circuit Description

Battery Control Circuit

The MCU can use PA1 to control the battery. When powered off, the user can press the button to turn on the power. When powered on, the MCU must keep PA1 high to ensure Q3 remains on. After the power is turned on, when the user press the button, the MCU will generate an external interrupt via INT1(PA6) and turn off the power via PA1.

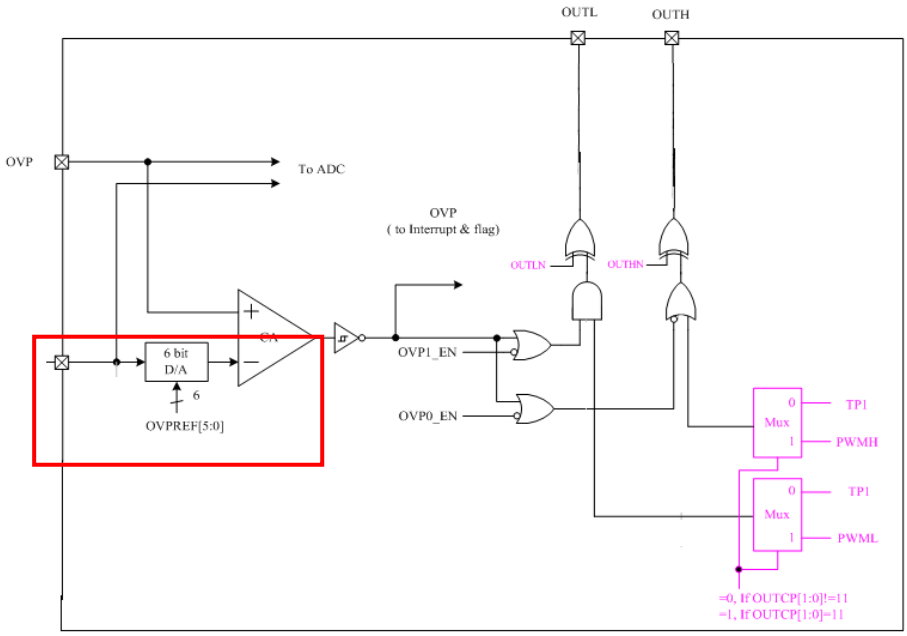


Charging IC Circuit

Use an IN4054 for lithium battery charging. Setup R13 to be 10K so that a 100mA constant current can be used.

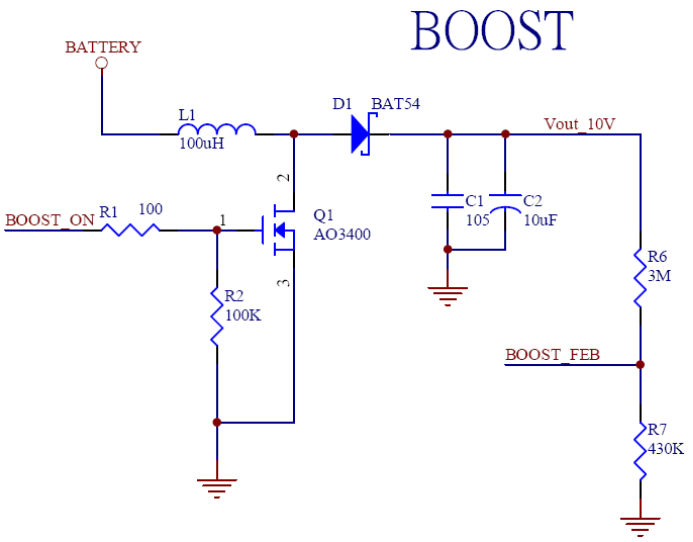
OVP Function Settings

Connect the OVP pin to the voltage dividing circuit which is output from the boost circuit. Setup the internal D/A reference voltage to come from VDD. Write a proper value to OVOREF[5:0] bits. When the boost circuit outputs a low voltage, the OUTH pin will automatically output a PWM signal to increase the boost voltage.



Boost Circuit

Use the BOOST_ON (MCU Pin 8, OUTH) PWM signal to control the Q1 on/off state. The energy stored in L1 is transferred and stored in C1 and C2, which together can generate a 10V boost voltage. A divided voltage generated using R6 and R7 is fed back to the MCU OVP function to maintain the boost out voltage at the correct level.



LCD Lens Control

The 3D glasses LCD lenses have 3-Line and 4-Line types. In this application, 3-Line controlled lenses are used. For the level shift circuits, whose power is supplied by the boost circuit, increase the LCD control voltage to 10V for the lens on/off control.

Battery Voltage Detect Circuit

Use the ADC to check the MCU internal band gap voltage, and select the ADC reference voltage to come from VDD. If the battery voltage falls below 3V, the VDD voltage will also fall below 3V. The band gap value detected at this moment will be higher than before, this indicating a VDD low voltage condition.

LED used as a Low Voltage Indicator

Main control MCU

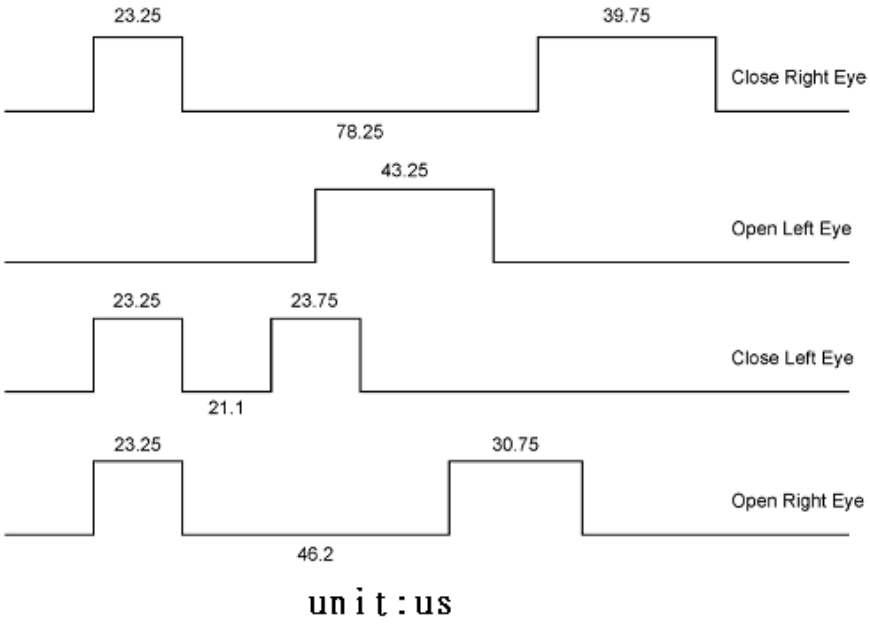
The main control MCU is the HT45FH3T-1, which has both integrated PWM and OVP circuits.

IR Receiver Circuit

In this circuit, tiny signals received by the IR photodiode will be filtered, amplified and integrated to generate the digital signals that can be processed by the MCU.

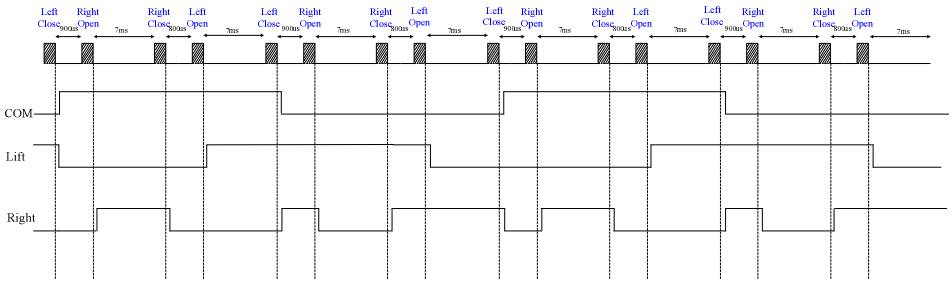
IR Signals and LCD Lens Control Description

Different 3D videos may generate different control signals, some IR signals have carrier signals while some signals are carrier-free. This application uses an nVIDIA protocol working together with IR signals with no carrier to implement decode operation and control the LCD lenses.



Note that LCD lenses must be properly controlled to avoid the liquid crystals remaining at the same voltage level for too long to avoid damage.

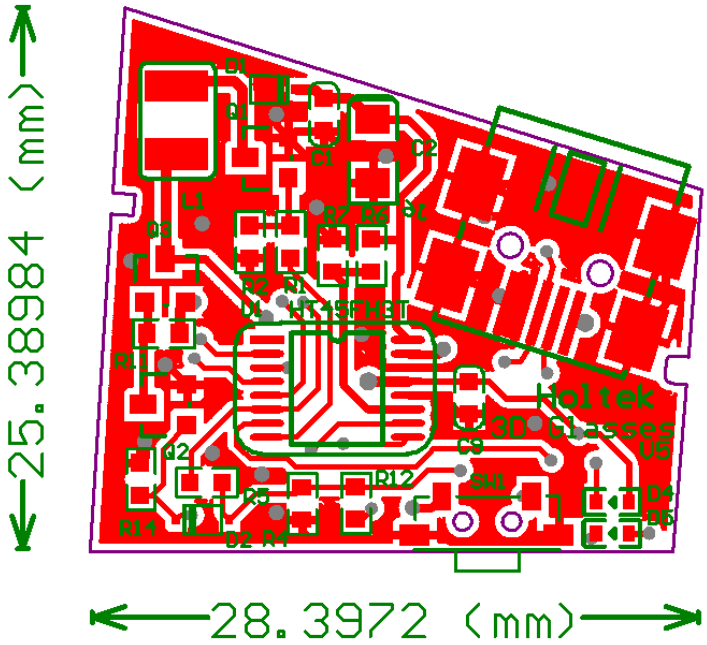
Basically, during a COM cycle, the positive level time and the negative level time are same for the same lens. This demo board uses 3-Line control mode, the liquid crystal level control and left/right lens control is shown below.



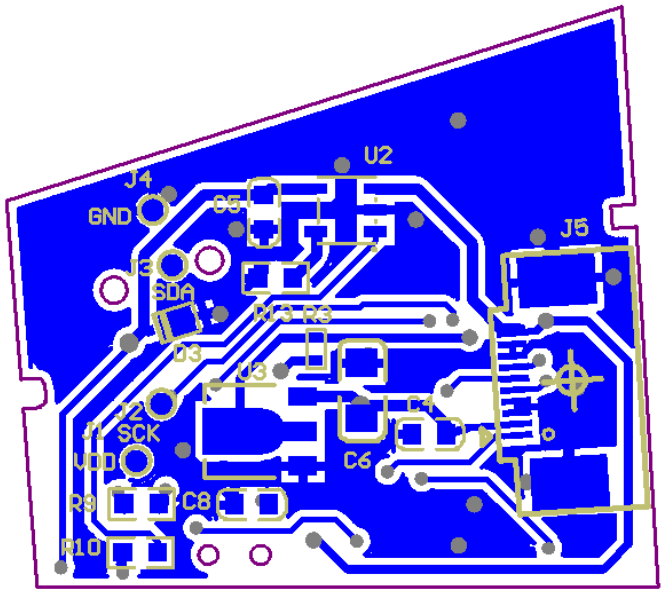
PCB Layout

Main Board

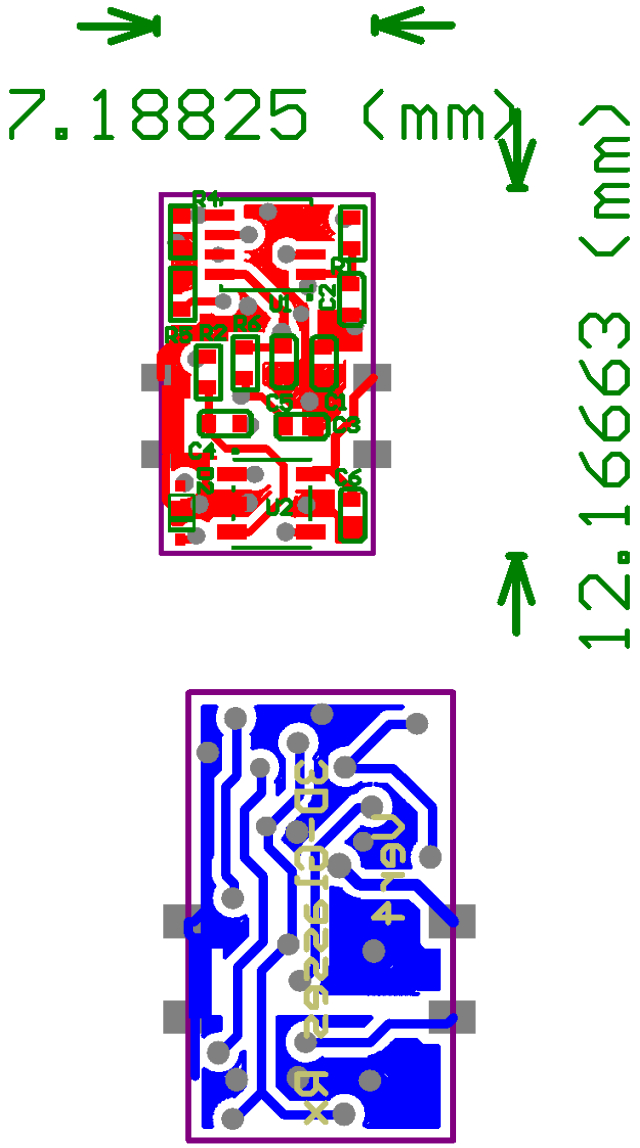
Front



Back



Receiver Board

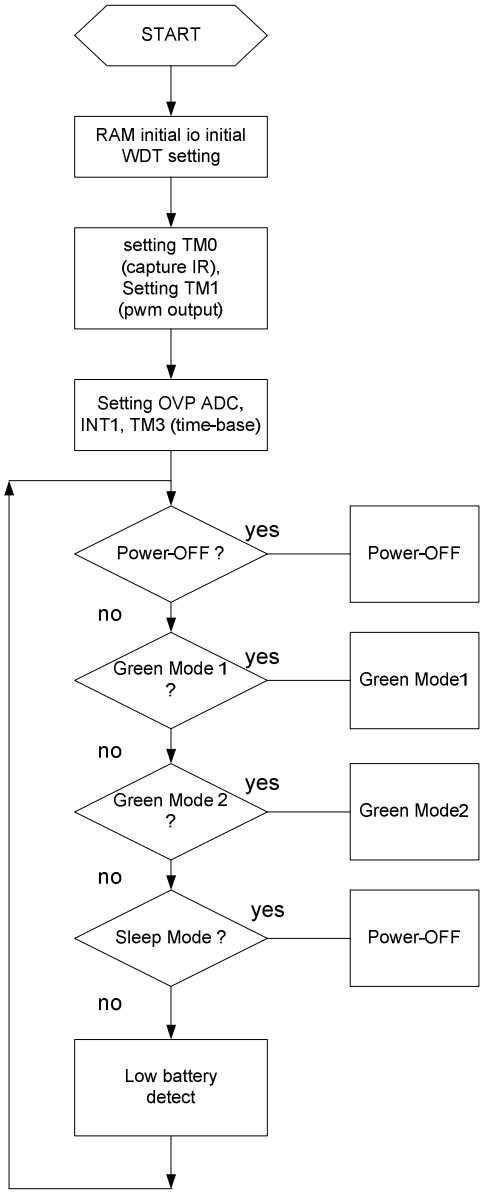


HT45FH3T 3D Glasses Demo Board – BOM Table

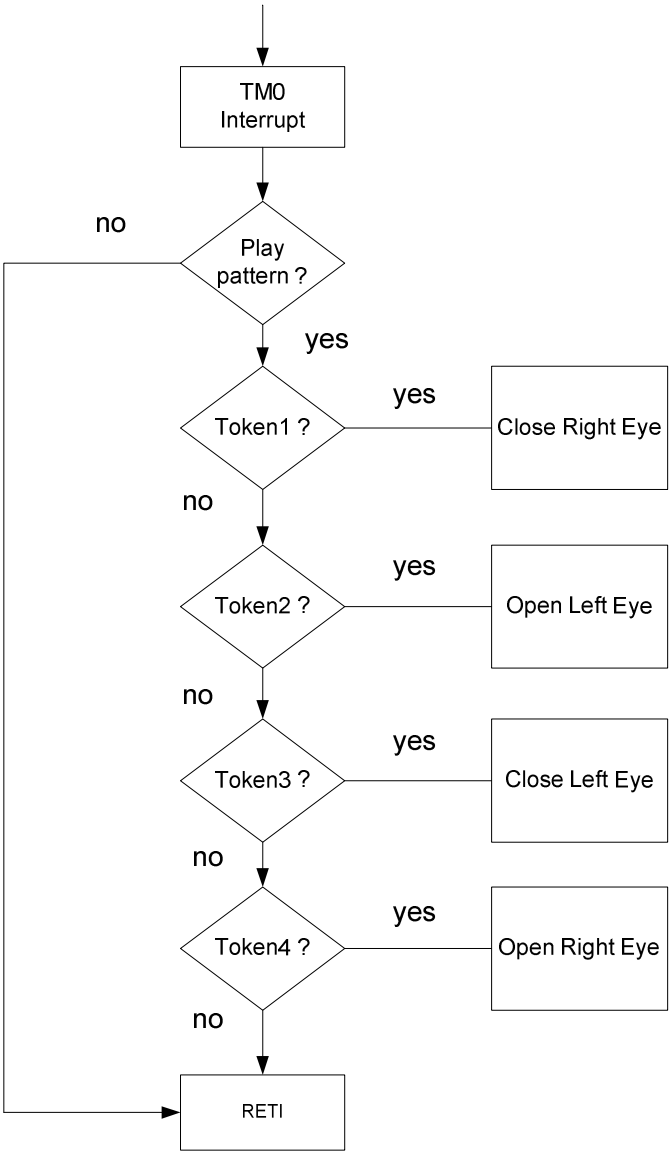
Main Board					
Type	**Symbol**	**Value**	**Package**	**Number**	**Note**
MCU	U1	HT45FH3T-1	SSOP16	1	
Charging IC	U2	IN4054	SOT23-5	1	
LDO	U3	HT7830	SOT89	1	
Capacitor	C9,C8	0.1uF	0603	2	
	C6	10uF	0805	1	
	C1,C2,C3,C4,C5	1uF	0603	5	
Resistor	R12	1K	0603	1	
	R14	1M	0603	1	
	R6	3.3M	0603	1	
	R13	10K	0603	1	
	R1	100	0603	1	
	R4,R2	100K	0603	2	
	R3	NC	0603	1	
	R7	360K	0603	1	
	R9,R10	470	0603	2	
	R11	470K	0603	1	
LED	D4,D5	Red, Yellow	0603	2	
Inductor	L1	100uH	SMD	1	
N-MOSFET	Q1,Q2	AO3400	SOT23	2	
P-MOSFE	Q3	AO3401	SOT23	1	
Diode	D1,D2,D3	BAT54	SOD232	3	
Button	SW1		SMD	1	
Connector	J5		FPC-0.5mm-10pin	1	
USB connector	J6		MINI USB	1	
TVS	D3		SOD323	1	
IR Receiver Board					
Type	**Symbol**	**Value**	**Package**	**Number**	**Note**
OPA	U1	OPA2348	SOT23-8	1	
Comparator	U2	LM7239	SOT23-5	1	
Capacitor	C4	4.7nF	0402	1	
	C5,C6	0.1uF	0402	2	
	C3	330pF	0402	1	
Resistor	R4,R2	2K	0402	2	
	R6	3M	0402	1	
	R5	7.15K	0402	1	
	R1	200K	0402	1	
Diode	D2	BAT54	SOD523	1	
Photodiode	D1	BPW 34		1	
summary				50	

Software Flowchart

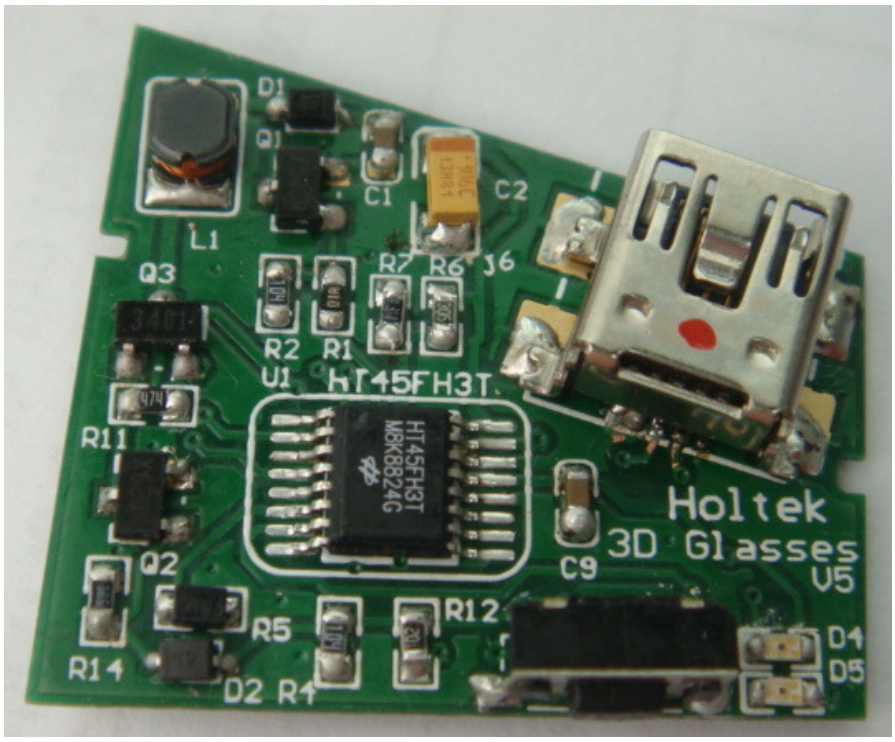
Main Architecture Flowchart



LCD Lenses Flowchart



Demo Board Pictures



Conclusions

As the demand for 3D glasses products is increasing, the HT45FH3T can be used to reduce additional circuit requirements and PCB area, thus reducing production costs.