

Using the HT46F47E in Digital Photoframe Backlight Applications

D/N: AN0154E
Introduction

Digital photoframes displays are TFT LCD types. Because the crystals inherently cannot emit illumination, a background illumination source is required, for which most types use an LED flat panel. The HT46F47E Demo Board can demonstrate two modes of LCD panel LED background lighting:

One mode is for automatic adjustment of illumination levels according to background light levels. (higher background illumination level results in higher LED background lighting level and vice-versa) The other mode is for manual adjustment of the illumination level for which 8 levels are provided.

HT46F47E Basic Characteristics

- Working Voltage:
 - $f_{clk}=4MHz: 2.2V-5.0V$
 - $f_{clk}=8MHz: 3.2V-5.0V$
 - $f_{clk}=12MHz: 4.5V-5.0V$
- 13 Bi-directional I/O lines
- Single external interrupt line shared with I/O line
- 8-bit Timer/Event Counter with 7-stage prescaler
- 2048x14 Flash Program Memory
- 128x8 EEPROM Data Memory
- 64x8 Data Memory RAM
- Internal RC Oscillator Circuit
- Watchdog Timer
- PFD for Audio Frequency Generation
- Power-down and wake-up for power conservation
- At VDD=5V, and 8MHz system frequency, instruction execution time = 0.5µs

- Table look-up instruction for 14-bit data
- 6-level stack
- Bit manipulation instruction
- 63 instructions
- 106 erase/write cycles EEPROM data memory
- EEPROM data retention > 10 years
- Low Voltage Reset Function
- In-system programming - ISP
- 18-pin DIP/SOP package types

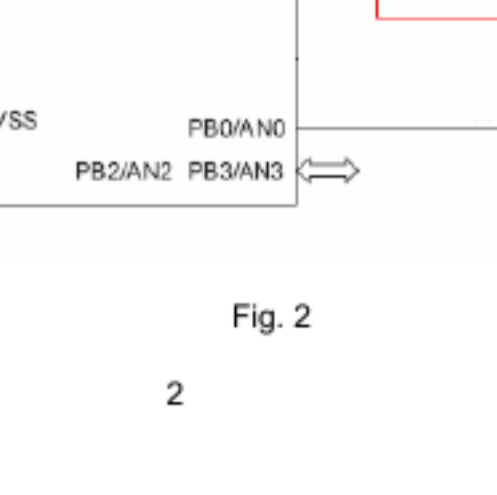


Fig. 1

Hardware Block Diagram

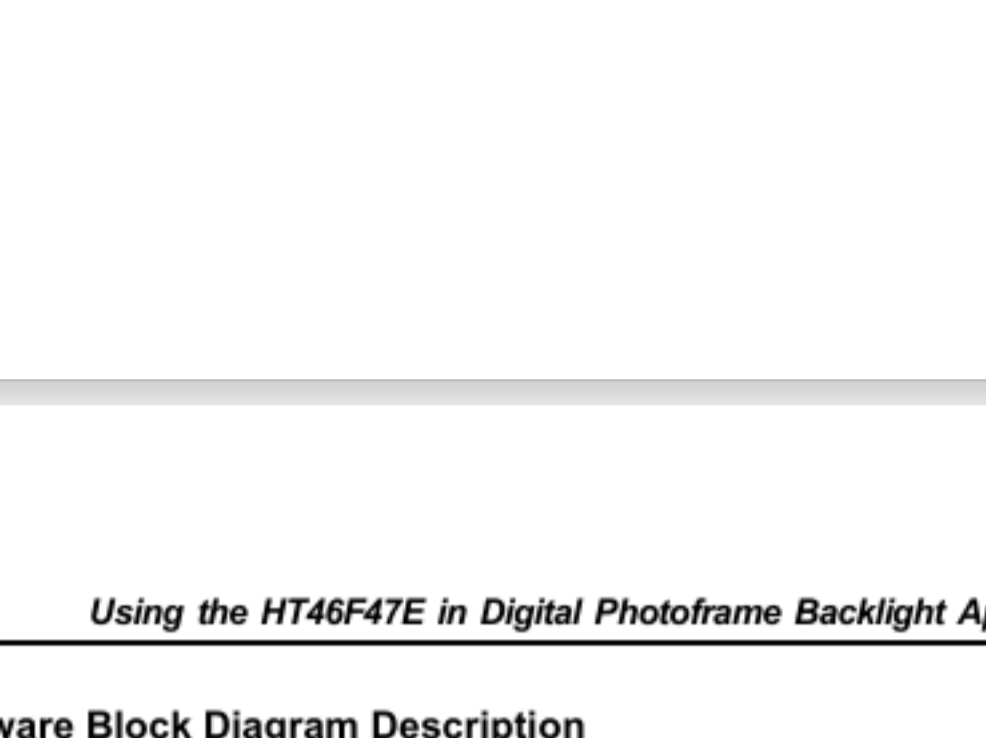


Fig. 2

Hardware Block Diagram Description

The complete hardware circuit includes function switch inputs, LED PWM drive circuit, AD feedback LED current sense circuit, photoresistor circuit etc.

The PWM output drives a 12V circuit for LED driving.

AN0 is used to measure the LED current value.

A photoresistor is used to measure the background illumination level.

Hardware Circuit Diagram

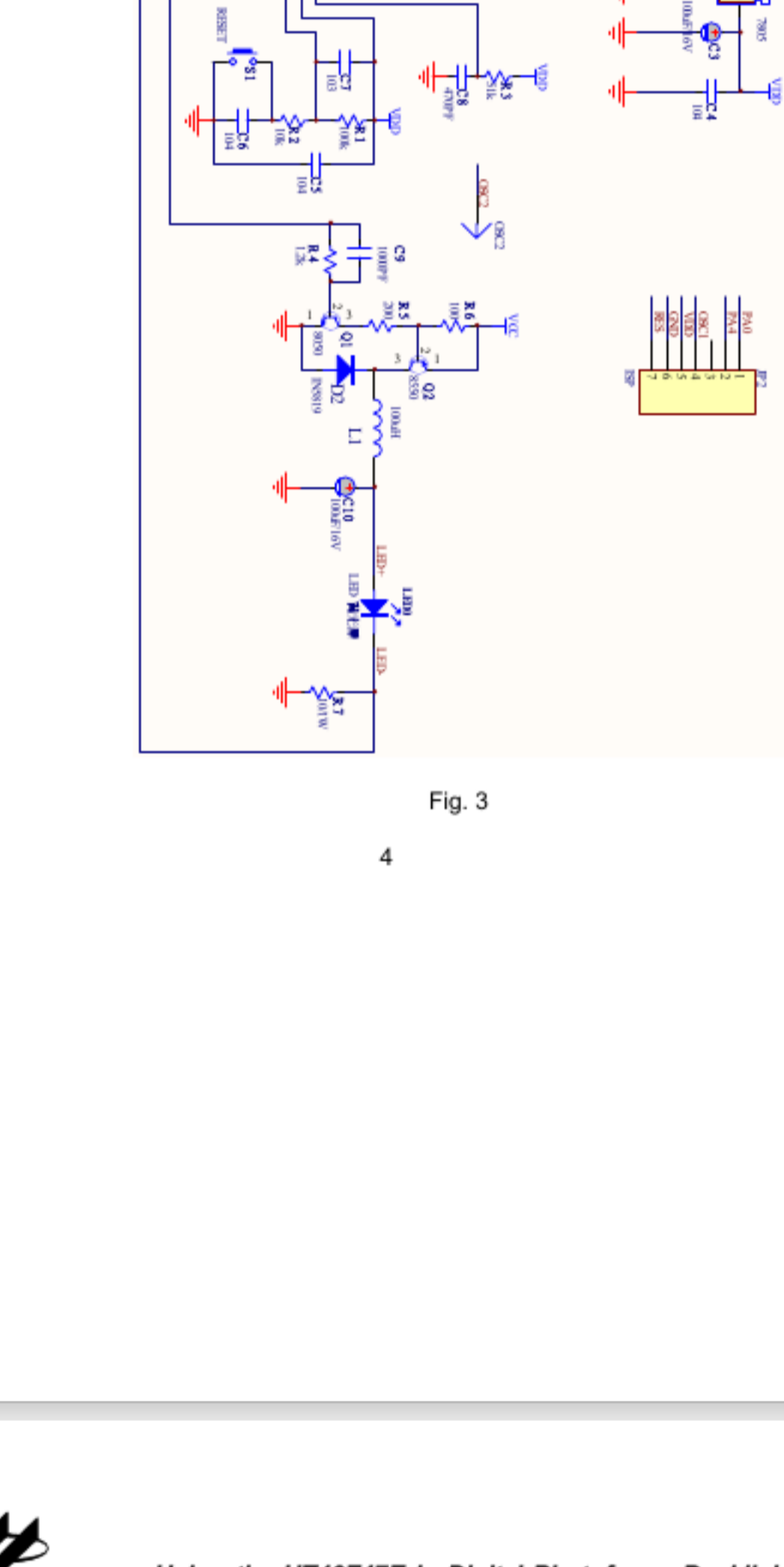


Fig. 3

Main Circuit Description

The LED backlight uses PWM voltage control and AD feedback to control the current. As shown in the above figure, when the PWM output is high, transistors Q1 and Q2 will be conducting. When the PWM output is low the two transistors will be off. In this way a varying markspace ratio PWM waveform is generated. After filtering and rectifying the square wave is changed into a more stable high level to drive the LED backlight. The larger the PWM then the larger the high level time and the higher the PWM signal the higher the LED current and the higher the illumination level. Using the AN0 input and the LED series connected resistor allows measurement of the LED current. This gives feedback to allow the PWM output to change its mark to space ratio to setup a fixed current and illumination level. The AN1 input is used to measure the voltage on a photoresistor, to setup the LED background light illumination level to compensate for different background illumination levels.

Software Design Description

Main Flowchart

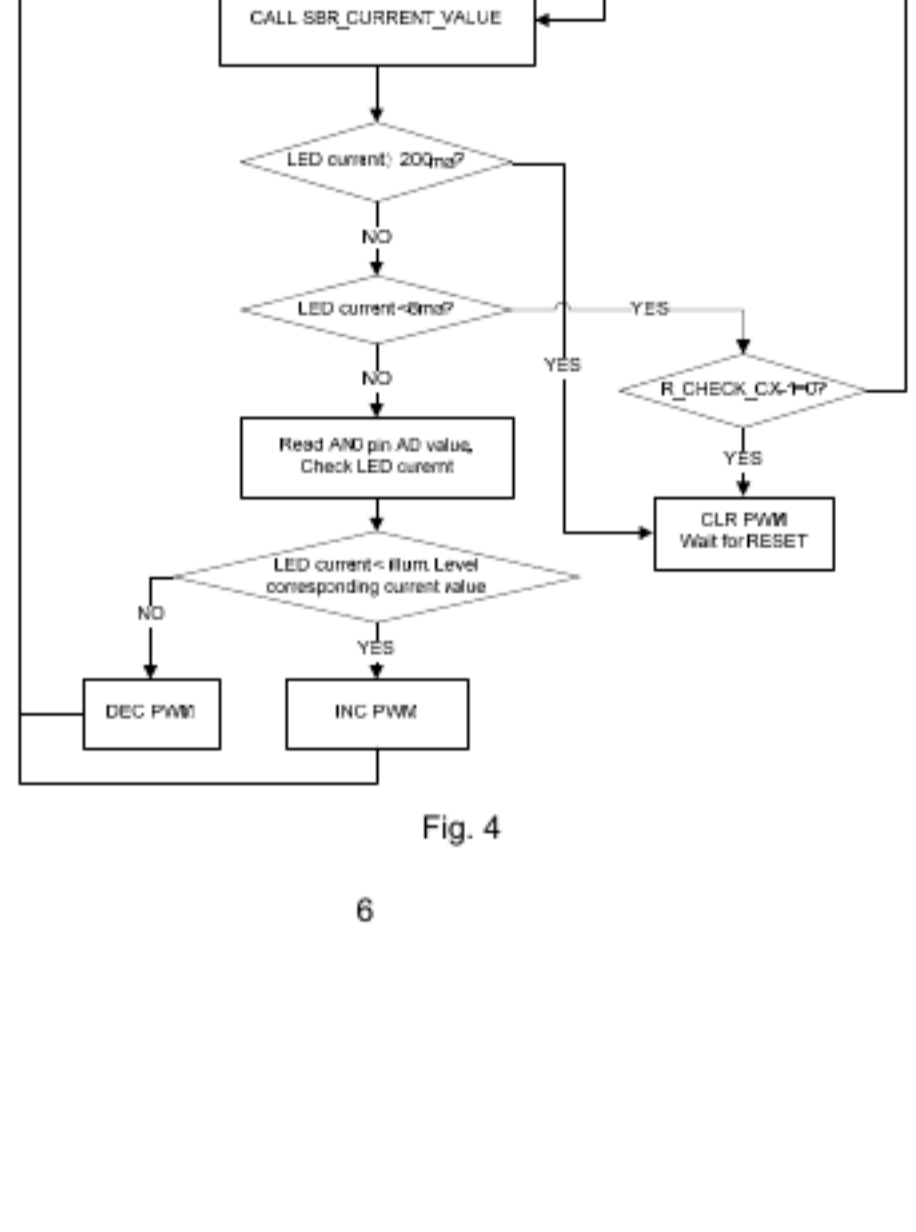


Fig. 4

Interrupt Program Flowchart

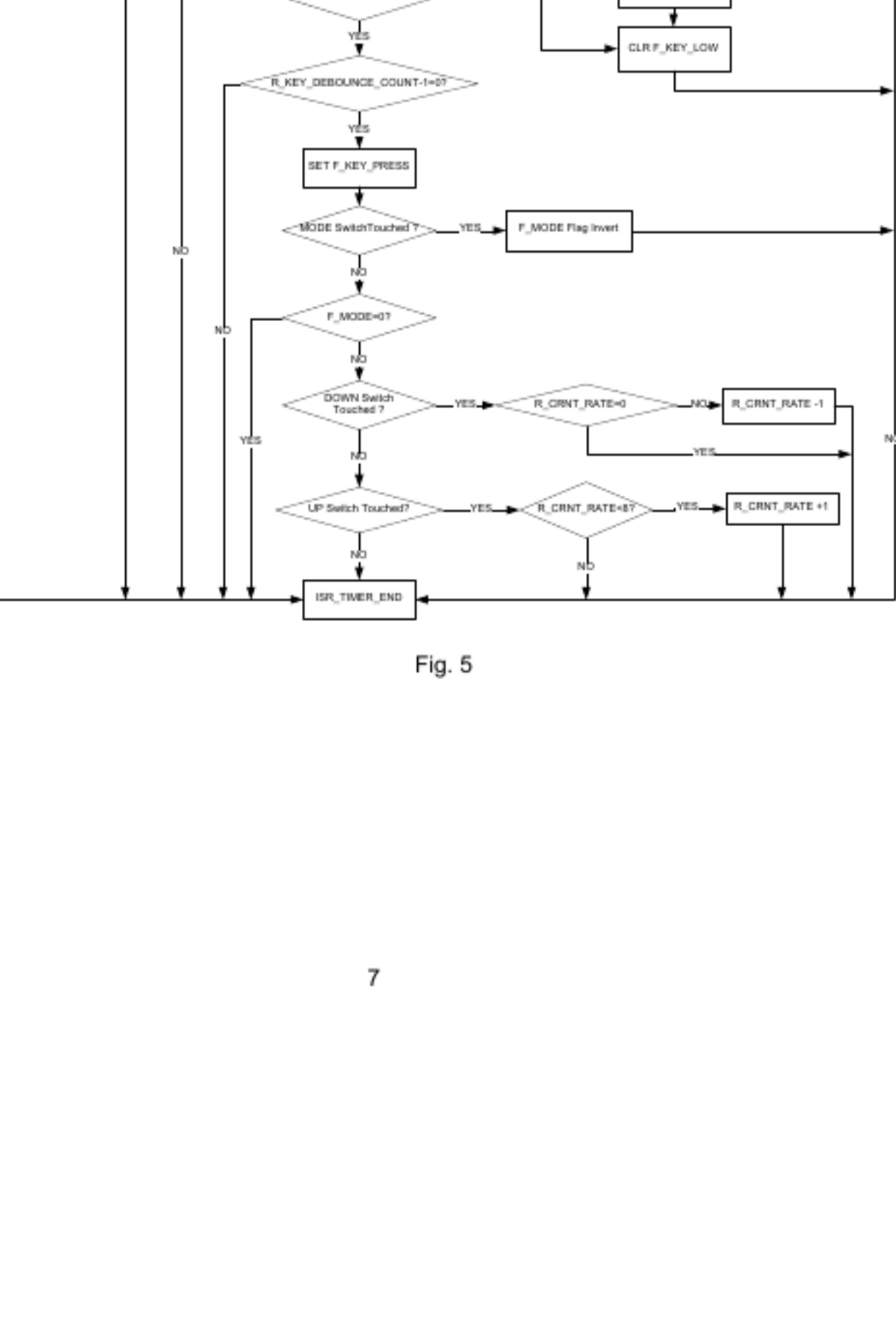


Fig. 5

Software Design Description

During Power-on, as the digital photoframe requires time to stabilize, the background light needs a delay of about 5 seconds before illuminating. However if the reset switch is pressed, the delay is not necessary. When the program starts, the program will look for the existence of an LED backlight, after which a value of 30H will be written into PWM and then the current measured to ensure it is within a range of 8-200mA. If not then the PWM output will be switched off and await a Reset or Power-on to ensure that the LED backlight current is less than 200mA.

PCB Layout



Fig. 6