

IS31FL3801

8-BIT MCU (32K FLASH AND 1K SRAM) WITH INTELLIGENT 16x8 MATRIX FXLED ENGINE AND CAP TOUCH SENSE

Preliminary Information
September 2019

GENERAL DESCRIPTION

IS31FL3801 is a general-purpose micro-controller with integrated general purpose 16x8 or 15x9 matrix LED driver.

The matrix LED driver can be programmed via micro-controller's 1MHz I2C interface, each of the LED dot can be dimmed individually with 8-bit PWM data and 8-bit DC scaling (Color Calibration) data which allowing 256 steps of linear PWM dimming and 256 steps of DC current adjustable level. Additionally each LED open and short state can be detected, IS31FL3801 store the open or short information in Open-Short Registers. The Open Short Registers allow 8051 CPU core to read out via I2C compatible interface. Inform external HOST whether there are LEDs open or short and the locations of open or short LEDs.

The micro-controller has 32K embedded flash memory and 1K SRAM. The CPU is based on 1-T 8051 with T0/T1/T2 and additional 16-bit T3/T4, 24-bit T5 and a 30-bit WDT. Embedded in the CPU core are also a full-duplex UART port, an enhanced EUART port with LIN capability, one I²C master and one I²C pure slave controllers, one SPI mater/slave controller, each GPIO pin configurable as external interrupt and wake up.

The flexibility in clock setting includes an on-chip 16MHz precision oscillator with the accuracy deviation of +/-2%, or a low power internal 32KHz oscillator. The clock selections are combined with flexible power management schemes, including NORMAL, PMM, IDLE, and STOP, and SLEEP modes to balance CPU speed and power consumption.

A Programmable Counter Array (PCA) with 6 channels of Capture/Compare/PWM modules can be used for various purposes controlling external devices. There are additional 2 independent 8-bit PWM and a buzzer waveform generator with frequency range of 128Hz to 2048Hz and programmable duty cycle.

Other digital peripherals include a EUART2 with 16-byte FIFO, which support full LIN protocols, and an I2C slave controller, and a SPI Master/Slave controller with 4-byte FIFO.

Analog peripherals include a high performance 12-bit Analog to Digital Converter (ADC) with 30usec conversion time and a Programmable Gain Amplifier as ADC front-end. There are an on-chip temperature sensor, and a calibrated voltage reference within the

ADC block. A 12-bit voltage output Digital to Analog Converter (DAC) is also included.

IS31FL3801 also provides a flexible means of flash programming that supports ISP and IAP. The protection of data loss is implemented in hardware by access restriction of critical storage segments. The code security is reinforced with sophisticated writer commands and ISP commands. The on-chip break point processor also allows easy debugging which can be integrated with ISP. Reliable power-on-reset circuit and low supply voltage detection allows reliable operations under harsh environments.

IS31FL3801 integrates an ultra-low power, fully integrated 15-channel solution for capacitive touch-buttons applications. The chip allows electrodes to project sense fields through any dielectric such as glass or plastic. On-chip calibration logic continuously monitors the environment and automatically adjusts on-and-off threshold levels to prevent false sensor activation.

The IS31FL3801 is available in RoHS compliant package QFN-60 (7mmx7mm). It operates over the temperature range of -40°C to +105°C.

FEATURES

MCU

CPU and Memory

- 1-Cycle 8051 CPU core up to 16MHz
- 16-bit Timers T0/T1/T2/T3/T4 and 24-bit T5
- Programmable 30-bit Watch Dog Timer
- Integrated break point controller and debug port through I2C slave
- External interrupts and wake up shared with GPIO pins
- Power saving modes – Normal, PMM, IDLE, STOP, and SLEEP modes
- Wake-Up noise filter – up to 4 msec
- 256B IRAM and 768B XRAM
- 32KB Flash Memory and 128B Information Block
- Code security and data loss protection
- Endurance: 100K cycles and Retention: 10 years @85°C

Clock Sources

- Internal oscillator at 16MHz of +/- 2% accuracy@-40°C to 85°C; +/- 5% accuracy@-40°C to 105°C
- Internal low power 32KHz oscillator

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Digital Peripherals

- 16-bit PCA and 6 channel of CCP modules
 - Capture/Compare/Timer Mode
 - 8/16-bit PWM Mode and 8-bit WPWM Mode
- 12 CH 8-bit PWM Controller
- One buzzer waveform generator
- One SPI Master/Slave Controllers
 - 4 bytes transmit and receive FIFO
- One 8051 UART
- One full-duplex LIN-capable EUART2
 - 16-bit baud rate register
 - 16 bytes transmit and receive FIFO

Analog Peripherals

- 12-bit monotonic SAR ADC
 - 500KHz, 128µsec conversion time (1.8~2.4V)
 - 4Mhz, 16µsec conversion time (2.5~5.5V)
 - Programmable Gain Amplifier
 - Up to 16 input shared with GPIO
 - Onchip 1.1V reference and temperature sensor
- 12-bit voltage output DAC
- 4-Channel Analog Comparator
- Capacitance sense touch-key controller scan up to 19 keys through shared GPIO
 - TK1 oscillator type
 - TK2 charge transfer type
- Power on reset (1.5V) and LVD/LVR (1.8V-5.5V)

Miscellaneous

- Up to 20 GPIO pins
- 2.2V to 5.5V single supply with on-chip 1.8V regulator. Operating down to 1.8V
- Active current < 300uA/MHz in NORMAL mode
- Low power standby (< 20uA) in SLEEP mode

Matrix LED Driver

- 16 current sinks
- 2.7 to 5.5V LED driver supply (VCC)
- Support 16×n (n=1~8) LED matrix configurations
- Individual 256 PWM control steps
- Individual 256 DC current steps

- 64 global current steps
- Internal SDB rising edge reset I2C module
- 29kHz PWM frequency
- Internal 1MHz I2C-compatible interface
- Individual open and short error detect function
- 180 degree phase delay operation to reduce power noise
- De-Ghost
- Spread Spectrum
- Miscellaneous
- Up to 16 GPIO pins
- 2.2V to 5.5V MCU supply (VDD) with on-chip 1.8V regulator. Operating down to 1.8V
- Active current < 300µA/MHz in NORMAL mode
- Low power standby (< 20µA) in SLEEP mode

Cap Touch Features

- Fifteen sensors capacitive touch controller with readable key value through shared GPIO
- Individual sensitivity threshold setting for each key
- Optional multiple-key function
- Press and hold function
- Automatic calibration
- Individual key calibration
- Interrupt output with auto-clear and repeating
- Auto sleep mode for extremely low power
- Keys wake up from sleep mode
- 400kHz fast-mode I²C interface
- One SPI master/slave controllers
- One 8051 UART
- One full-duplex LIN-capable EUART2

APPLICATIONS

- Gaming device (Mouse, Mouse MAT etc.)
- IOT device (AI speaker etc.)
- White goods display panel

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TYPICAL APPLICATION CIRCUIT

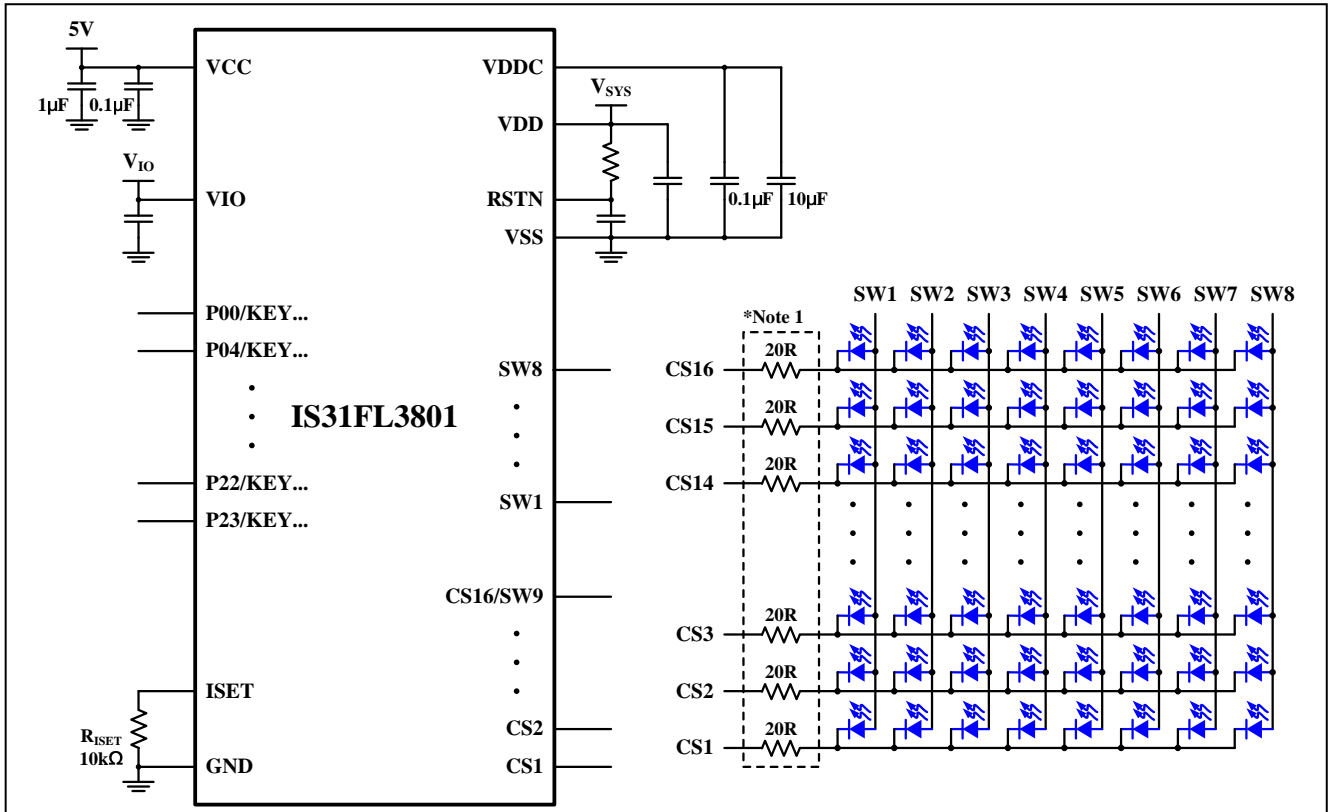


Figure 1 Typical Application Circuit

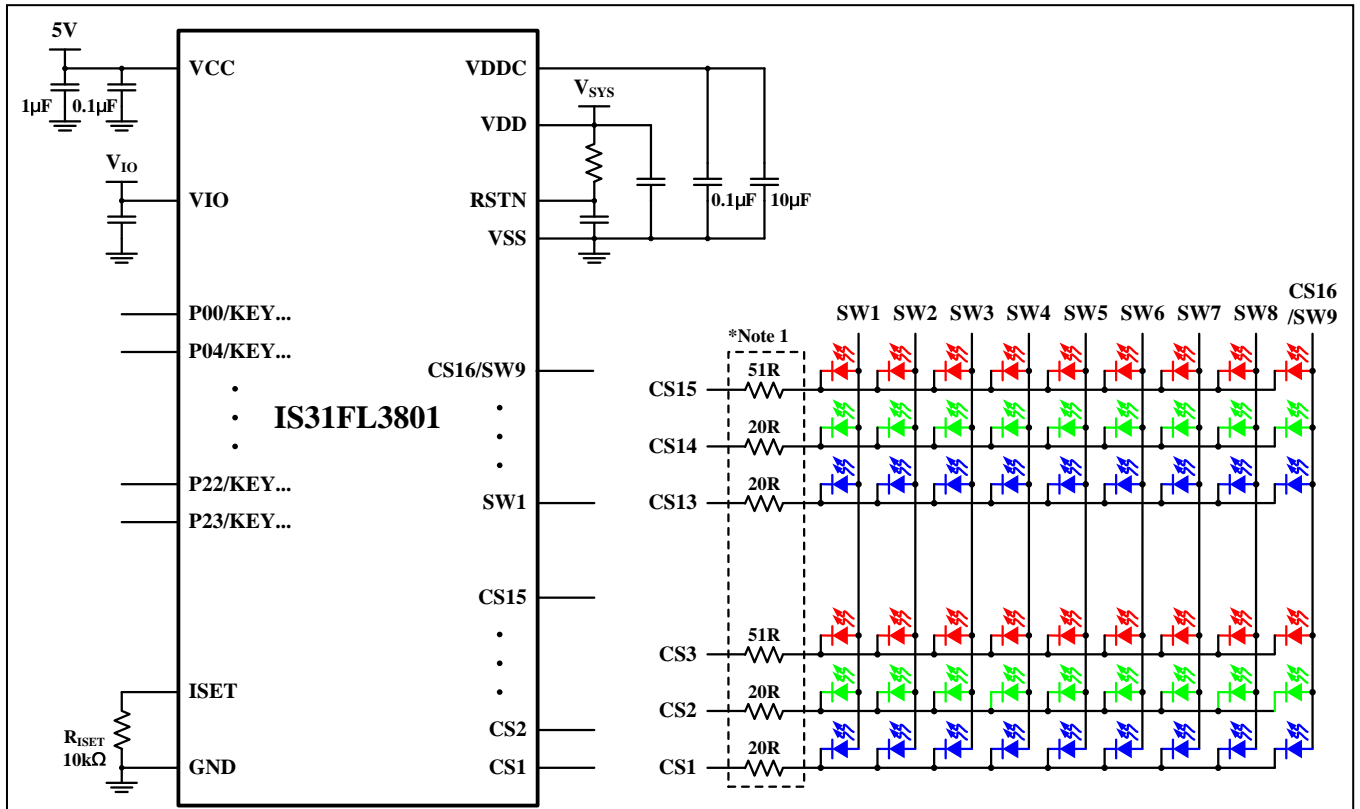


Figure 2 Typical Application Circuit

Note 1: The 20R or 51R resistors between LED and IC are only for thermal reduction, for mono red LED, if $V_{CC}=3.3V$, don't need these resistors.