Erriez TM1638 library for Arduino

1.2.0

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Contents

Chapter 1

Optimized TM1638 library for Arduino

This is a 3-pin serial TM1638 chip library for Arduino, optimized for size and speed. It supports a combined LED driver controller and key-scan interface to detect multiple key presses at the same time.

Displaying numbers, characters and reading keys depends on the hardware wiring and is not part of this library. A fully operational example for a board with 8 7-segment displays, 8 dual color LED's and 8 buttons which uses this library is available here: `JY-LKM1638`.

Hardware

Connect power and 3 data pins to an Arduino board DIGITAL pins:

- VDD (Power 3.3V - 5V)
- GND (Ground)
- DIO (Bi-directional data input/output)
- STB (Chip select)
- CLK (Clock)

The following TM1638 pins should be connected to LED's and buttons in a matrix:

- K1∼K3 (Key-scan data input to read multiple key presses at the same time)
- SEG/GRID (Output for LED matrix)

Pins

Pin	TM1638	Arduino UNO / Nano / Micro / Pro Micro / Leonardo / Mega2560	WeMos D1 & R2 / Node MCU	WeMos LOLIN32
1	VCC	5V (or 3.3V)	3V3	3V3
2	GND	GND	GND	GND
3	CLK	2 (DIGITAL pin)	D2	0
4	DIO	3 (DIGITAL pin)	D3	4
5	STB0	4 (DIGITAL pin)	D4	5

- Check maximum regulator / diode current to prevent a burnout when using lots of LED's. Some boards can provide only 100mA, others 800mA max.

Example

Arduino IDE | Examples | Erriez TM1638 button and LED driver:

- ErriezTM1638

Documentation

- Doxygen online HTML
- Doxygen PDF
- TM1638 Datasheet

Usage

Initialization

```
{c++}
// Include TM1638 library
#include <ErriezTM1638.h>

// Connect display pins to the Arduino DIGITAL pins
#define TM1638_CLK_PIN   2
#define TM1638_DIO_PIN   3
#define TM1638_STB_PIN   4

// Create tm1638 object
TM1638 tm1638(TM1638_CLK_PIN, TM1638_DIO_PIN, TM1638_STB_PIN);

void setup()
{
    // Initialize TM1638
    tm1638.begin();
}
```

Display on/off

```
{c++}
// Turn display off
tm1638.displayOff();

// Turn display on
tm1638.displayOn();
```

Turn all LED's off

```
{c++}
// Turn all LED's off
tm1638.clear();
```

Get keys

```
{c++}
// Get 32-bit key-scan
uint32_t keys = tm1638.getKeys();
```

Write Byte to display register

```
{c++}
// Write segment LED's to the first display registers 0x00..0x0F with value 0x00..0xff to
// display numbers and characters. Just an example which depends on the hardware:
tm1638.writeData(0x01, 0x01);
```

Write buffer to display registers

```
{c++}
// Creat buffer with LED's
uint8_t buf[] = { 0b10000110, 0b00111111, 0b00111111, 0b00111111, 0b00111111, 0b00111111};

// Write buffer to TM1638
tm1638.writeData(0x00, buf, sizeof(buf));
```

Small footprint

Measured with Arduino IDE v1.8.5 without any other peripherals, calling all library functions once:

Board	MCU flash size	MCU RAM size	TM1638 library flash	TM1638 library RAM
Arduino UNO	32kB	2048kB	1840 Bytes	40 Bytes

Optimized timing

The library uses optimized pin control for AVR targets. Other targets uses the default digitalRead() and digitalWrite() pin control functions.

Output `Benchmark` example:

Board	CLK	Read keys	Write Byte	Write 16 Bytes buffer	Clear display
Pro Mini 8MHz	65kHz	736us	312us	2448us	2224us
UNO 16MHz	125kHz	340us	152us	1192us	1176us
WeMos D1 & R2 80MHz	200kHz	284us	116us	683us	682us
WeMos D1 & R2 160MHz	300kHz	223us	66us	474us	469us

Arduino UNO 16MHz

WeMos D1 & R2 80MHz

WeMos D1 & R2 160MHz

Library dependencies

- The `ErriezTM1638Benchmark` example uses `Erriez Timestamp` library.

Library installation

Please refer to the Wiki page.

Other Arduino Libraries and Sketches from Erriez

- Erriez Libraries and Sketches

Chapter 2

Class Index

2.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 3

File Index

3.1 File List

Here is a list of all documented files with brief descriptions:

Chapter 4

Class Documentation

4.1 TM1638 Class Reference

TM1638 class.

`#include <ErriezTM1638.h>`

Public Member Functions

- TM1638 (uint8_t clkPin, uint8_t dioPin, uint8_t stbPin, bool displayOn=true, uint8_t brightness=5)

  TM1638 constructor.
- virtual void begin ()

  Initialize TM1638 controller.
- virtual void end ()

  Disable pins.
- virtual void displayOn ()

  Turn Display on.
- virtual void displayOff ()

  Turn display off.
- virtual void setBrightness (uint8_t brightness)

  Set brightness LED's.
- virtual void clear ()

  Turn all LED's off.
- virtual void writeData (uint8_t address, uint8_t data)

  Write display register.
- virtual void writeData (uint8_t address, const uint8_t *buf, uint8_t len)

  Write buffer to multiple display registers.
- virtual uint32_t getKeys ()

  Get key states.

Protected Member Functions

- virtual void writeDisplayControl ()
  Write display control register.
- virtual void writeCommand (uint8_t cmd)
  Write command to TM1638.
- virtual void writeByte (uint8_t data)
  Write byte to TM1638.
- virtual uint8_t readByte ()
  Read byte from TM1638.

Protected Attributes

- uint8_t _clkPin
  Clock pin.
- uint8_t _dioPin
  Data pin.
- uint8_t _stbPin
  Enable pin.
- bool _displayOn
  Display on and off status for display control register.
- uint8_t _brightness
  Display brightness for display control register.

4.1.1 Detailed Description

TM1638 class.

Definition at line 154 of file ErriezTM1638.h.

4.1.2 Constructor & Destructor Documentation

4.1.2.1 TM1638()

```
TM1638::TM1638 (
            uint8_t clkPin,
            uint8_t dioPin,
            uint8_t stbPin,
            bool displayOn = true,
            uint8_t brightness = 5 )
```

TM1638 constructor.

Constructor with pin arguments: C-D-E (Clock, Data, Enable)

Parameters

clkPin	TM1638 CLK pin.
dioPin	TM1638 DIO pin.
stbPin	TM1638 STB pin.

Definition at line 43 of file ErriezTM1638.cpp.

4.1.3 Member Function Documentation

4.1.3.1 getKeys()

```
uint32_t TM1638::getKeys ( )  [virtual]
```

Get key states.

Returns

One or more buttons. One bit per button.

Definition at line 190 of file ErriezTM1638.cpp.

4.1.3.2 readByte()

```
uint8_t TM1638::readByte ( )  [protected], [virtual]
```

Read byte from TM1638.

Returns

8-bit value.

Definition at line 251 of file ErriezTM1638.cpp.

4.1.3.3 setBrightness()

```
void TM1638::setBrightness (
            uint8_t brightness )  [virtual]
```

Set brightness LED's.

Parameters

brightness	Display brightness value 0..7

Definition at line 124 of file ErriezTM1638.cpp.

4.1.3.4 writeByte()

```
void TM1638::writeByte (
            uint8_t data )  [protected], [virtual]
```

Write byte to TM1638.

Parameters

data	8-bit value.

Definition at line 232 of file ErriezTM1638.cpp.

4.1.3.5 writeData() [1/2]

```
void TM1638::writeData (
            uint8_t address,
            uint8_t data )  [virtual]
```

Write display register.

Parameters

address	Display address 0x00..0x0F
data	Value 0x00..0xFF

Definition at line 151 of file ErriezTM1638.cpp.

4.1.3.6 writeData() [2/2]

```
void TM1638::writeData (
            uint8_t address,
            const uint8_t * buf,
            uint8_t len )  [virtual]
```

Write buffer to multiple display registers.

Write buffer to TM1638 with auto address increment

Parameters

address	Display address 0x00..0x0F
buf	Buffer
len	Buffer length

Definition at line 173 of file ErriezTM1638.cpp.

4.1.3.7 writeDisplayControl()

```
void TM1638::writeDisplayControl ( )  [protected], [virtual]
```

Write display control register.

Set brightness and display on/off

Definition at line 211 of file ErriezTM1638.cpp.

The documentation for this class was generated from the following files:

- src/ErriezTM1638.h
- src/ErriezTM1638.cpp

Chapter 5

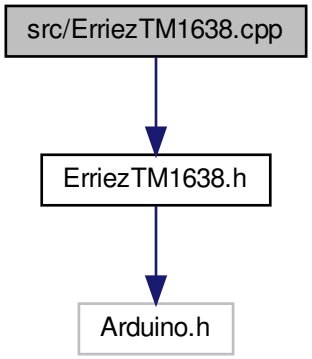
File Documentation

5.1 src/ErriezTM1638.cpp File Reference

TM1638 library for Arduino.

```
#include "ErriezTM1638.h"
```

Include dependency graph for ErriezTM1638.cpp:



5.1.1 Detailed Description

TM1638 library for Arduino.

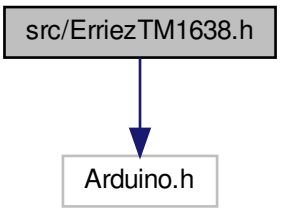
Source: https://github.com/Erriez/ErriezTM1638 Documentation: https://erriez.↩
github.io/ErriezTM1638

5.2 src/ErriezTM1638.h File Reference

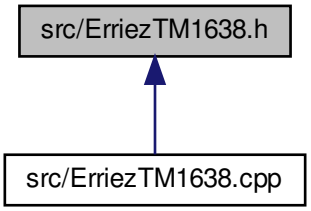
TM1638 library for Arduino.

```
#include <Arduino.h>
```

Include dependency graph for ErriezTM1638.h:



This graph shows which files directly or indirectly include this file:



Classes

- class TM1638

  TM1638 class.

Macros

- #define TM1638_CMD_DATA 0x40

  Display data command.
- #define TM1638_CMD_CTRL 0x80

  Display control command.
- #define TM1638_CMD_ADDR 0xc0

  Display address command.
- #define TM1638_DATA_WRITE 0x00

Write data.

- #define TM1638_DATA_READ_KEYS 0x02

  Read keys.
- #define TM1638_DATA_AUTO_INC_ADDR 0x00

  Auto increment address.
- #define TM1638_DATA_FIXED_ADDR 0x04

  Fixed address.
- #define TM1638_CTRL_PULSE_1_16 0x00

  Pulse width 1/16.
- #define TM1638_CTRL_PULSE_2_16 0x01

  Pulse width 2/16.
- #define TM1638_CTRL_PULSE_4_16 0x02

  Pulse width 4/16.
- #define TM1638_CTRL_PULSE_10_16 0x03

  Pulse width 10/16.
- #define TM1638_CTRL_PULSE_11_16 0x04

  Pulse width 11/16.
- #define TM1638_CTRL_PULSE_12_16 0x05

  Pulse width 12/16.
- #define TM1638_CTRL_PULSE_13_16 0x06

  Pulse width 13/16.
- #define TM1638_CTRL_PULSE_14_16 0x07

  Pulse width 14/16.
- #define TM1638_CTRL_DISPLAY_OFF 0x00

  Display off.
- #define TM1638_CTRL_DISPLAY_ON 0x08

  Display on.
- #define TM1638_NUM_GRIDS 16

  Number of grid registers.
- #define TM1638_CLK_LOW() { digitalWrite(_clkPin, LOW); }

  CLK pin low.
- #define TM1638_CLK_HIGH() { digitalWrite(_clkPin, HIGH); }

  CLK pin high.
- #define TM1638_CLK_INPUT() { pinMode(_clkPin, INPUT); }

  CLK pin input.
- #define TM1638_CLK_OUTPUT() { pinMode(_clkPin, OUTPUT); }

  CLK pin output.
- #define TM1638_DIO_LOW() { digitalWrite(_dioPin, LOW); }

  DIO pin low.
- #define TM1638_DIO_HIGH() { digitalWrite(_dioPin, HIGH); }

  DIO pin high.
- #define TM1638_DIO_INPUT() { pinMode(_dioPin, INPUT); }

  DIO pin input.
- #define TM1638_DIO_OUTPUT() { pinMode(_dioPin, OUTPUT); }

  DIO pin output.
- #define TM1638_DIO_READ() (digitalRead(_dioPin))

  DIO pin read.
- #define TM1638_STB_LOW() { digitalWrite(_stbPin, LOW); }

  STB pin low.
- #define TM1638_STB_HIGH() { digitalWrite(_stbPin, HIGH); }

  STB pin high.

- #define TM1638_STB_INPUT() { pinMode(_stbPin, INPUT); }

  STB pin input.
- #define TM1638_STB_OUTPUT() { pinMode(_stbPin, OUTPUT); }

  STB pin output.
- #define TM1638_PIN_DELAY()

  Delay between pin changes.

5.2.1 Detailed Description

TM1638 library for Arduino.

Source: https://github.com/Erriez/ErriezTM1638 Documentation: https://erriez.github.io/ErriezTM1638

```
Command / register definitions

MSB           LSB
 7 6 5 4 3 2 1 0
-----------------
 0 1 - - - - - -    Data command
 1 0 - - - - - -    Display control command
 1 1 - - - - - -    Address command


7.1 Data Command Set

MSB           LSB
 7 6 5 4 3 2 1 0
-----------------
 0 1 0 0 0 - 0 0    Write display data
 0 1 0 0 0 - 1 0    Read key scan data
 0 1 0 0 0 0 - -    Auto address increment
 0 1 0 0 0 1 - -    Fixed address


7.2 Address command set

MSB           LSB
 7 6 5 4 3 2 1 0
-----------------
 1 1 0 - A A A A    Address 0x00..0x0F


7.3 Display Control

MSB           LSB
 7 6 5 4 3 2 1 0
-----------------
 1 0 0 0 - 0 0 0    Set the pulse width of 1 / 16
 1 0 0 0 - 0 0 1    Set the pulse width of 2 / 16
 1 0 0 0 - 0 1 0    Set the pulse width of 4 / 16
 1 0 0 0 - 0 1 1    Set the pulse width of 10 / 16
 1 0 0 0 - 1 0 0    Set the pulse width of 11 / 16
 1 0 0 0 - 1 0 1    Set the pulse width of 12 / 16
 1 0 0 0 - 1 1 0    Set the pulse width of 13 / 16
 1 0 0 0 - 1 1 1    Set the pulse width of 14 / 16
 1 0 0 0 0 - - -    Display off
 1 0 0 0 1 - - -    Display on
```

5.2.2 Macro Definition Documentation

5.2.2.1 TM1638_CTRL_DISPLAY_ON

```
#define TM1638_CTRL_DISPLAY_ON 0x08
```

Display on.

Pin defines

Definition at line 105 of file ErriezTM1638.h.

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