

TM1638 library for Arduino

1.1.0

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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 / Pro Micro / Mega2560 / Leonardo	WeMos D1 & R2 / Node MCU	WeMos LOLIN32
1	VCC	5V (or 3.3V)	GND	GND
2	GND	GND	3V3	3V3
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

- Examples | Erriez [TM1638](#) | [Example](#)

Usage

Initialization

```
{c++}
// Include TM1638 library
#include "TM1638.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 [Benchmark](#) example uses [Erriez Timestamp](#) library.

Documentation

- [Doxygen online HTML](#)
- [Doxygen PDF](#)
- [TM1638 Datasheet](#)

Library installation

Please refer to the [Wiki](#) page.

Chapter 2

Class Index

2.1 Class List

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

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Chapter 3

File Index

3.1 File List

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

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Chapter 4

Class Documentation

4.1 TM1638 Class Reference

TM1638 class.

```
#include <TM1638.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 152 of file [TM1638.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

<i>clkPin</i>	TM1638 CLK pin.
<i>dioPin</i>	TM1638 DIO pin.
<i>stbPin</i>	TM1638 STB pin.

Definition at line 41 of file TM1638.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 188 of file TM1638.cpp.

4.1.3.2 `readByte()`

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

Read byte from [TM1638](#).

Returns

8-bit value.

Definition at line 249 of file TM1638.cpp.

4.1.3.3 `setBrightness()`

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

Set brightness LED's.

Parameters

<i>brightness</i>	Display brightness value 0..7
-------------------	-------------------------------

Definition at line 122 of file TM1638.cpp.

4.1.3.4 writeByte()

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

Write byte to [TM1638](#).

Parameters

<i>data</i>	8-bit value.
-------------	--------------

Definition at line 230 of file TM1638.cpp.

4.1.3.5 writeData() [1/2]

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

Write display register.

Parameters

<i>address</i>	Display address 0x00..0x0F
<i>data</i>	Value 0x00..0xFF

Definition at line 149 of file TM1638.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

<i>address</i>	Display address 0x00..0x0F
<i>buf</i>	Buffer
<i>len</i>	Buffer length

Definition at line 171 of file TM1638.cpp.

4.1.3.7 writeDisplayControl()

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

Write display control register.

Set brightness and display on/off

Definition at line 209 of file TM1638.cpp.

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

- [TM1638.h](#)
- [TM1638.cpp](#)

Chapter 5

File Documentation

5.1 TM1638.cpp File Reference

TM1638 library for Arduino.

```
#include "TM1638.h"
```

5.1.1 Detailed Description

TM1638 library for Arduino.

Source: <https://github.com/Erriez/ErriezTM1638>

5.2 TM1638.h File Reference

TM1638 library for Arduino.

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

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>

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 103 of file TM1638.h.

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