

Erriez TM1638 library for Arduino

1.1.0

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Chapter 1

Optimized TM1637 library for Arduino

This is a 2-pin serial [TM1637](#) chip library for Arduino, optimized for size and speed. It supports a combined LED driver controller and key-scan interface to detect one key press.

Chip features

- Power CMOS process
- Display mode (8 segments × 6 digits), support common anode LED output
- Key scan (8 × 2-bit), enhanced anti-jamming button recognition circuit
- Brightness adjustment circuit (adjustable duty cycle 8)
- Two-wire serial interface (CLK, DIO)
- Oscillation mode: Built-in RC oscillator
- Built-in power-on reset circuit
- Built-in automatic blanking circuit
- Package: DIP20 / SOP20

Hardware

Connect power and 2 data pins to an Arduino board DIGITAL pins:

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

The following [TM1637](#) pins should be connected to LED's and buttons in a matrix:

- K1~K2 (Key-scan data input to read one key press after each other)
- SEG/GRID (Output for LED matrix)

Pins

Pin	TM1637	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

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

Two-wire serial interface

The [TM1637](#) communicates with a MCU serial by using two wires:

- DIO (bi-directional input/output pin)
- SCL (Clock pin)

Note: The serial interface is not compatible with I2C or TWI, because no device address with read/write bit is used.

Example

Arduino IDE | Examples | Erriez [TM1637](#) button and LED driver:

[TM1637](#)

Documentation

- [Doxygen online HTML](#)
- [Doxygen PDF](#)
- [TM1637 Datasheet \(Chinese\)](#)

Usage

Initialization

```

1 {c++}
2 // Include TM1637 library
3 #include <ErriezTM1637.h>
4
5 // Connect display pins to the Arduino DIGITAL pins
6 #define TM1637_CLK_PIN 2
7 #define TM1637_DIO_PIN 3
8
9 // Create tml637 object
10 TM1637 tml637(TM1637_CLK_PIN, TM1637_DIO_PIN);
11
12 void setup()
13 {
14     // Initialize TM1637
15     tml637.begin();
16 }
```

Display on/off

```
1 {c++}
2 // Turn display off
3 tm1637.displayOff();
4
5 // Turn display on
6 tm1637.displayOn();
```

Turn all LED's off

```
1 {c++}
2 // Turn all LED's off
3 tm1637.clear();
```

Get keys

```
1 {c++}
2 // Get 8-bit key-scan
3 uint8_t keys = tm1637.getKeys();
```

Write Byte to display register

```
1 {c++}
2 // Write segment LED's to the first display registers 0x00..0x0F with value 0x00..0xff to
3 // display numbers and characters. Just an example which depends on the hardware:
4 tm1637.writeData(0x01, 0x01);
```

Write buffer to display registers

```
1 {c++}
2 // Creat buffer with LED's
3 uint8_t buf[] = { 0b10000110, 0b00111111, 0b00111111, 0b00111111, 0b00111111, 0b00111111};
4
5 // Write buffer to TM1637
6 tm1637.writeData(0x00, buf, sizeof(buf));
```

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	84kHz	352us	344us	1080us	1072us
UNO 16MHz	170kHz	156us	152us	496us	480us
WeMos D1 & R2 80MHz	205kHz	261us	137us	396us	396us
WeMos D1 & R2 160MHz	300kHz	233us	96us	275us	271us

Arduino Pro-Mini 8MHz

Arduino UNO 16MHz

WeMos D1 & R2 80MHz

WeMos D1 & R2 160MHz

Library dependencies

- The [Benchmark](#) 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:

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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 TM1637 Class Reference

TM1637 class.

```
#include <ErriezTM1637.h>
```

Public Member Functions

- **TM1637** (uint8_t clkPin, uint8_t dioPin, bool **displayOn**=true, uint8_t brightness=5)
TM1637 constructor.
- virtual void **begin** ()
Initialize TM1637 controller.
- virtual void **end** ()
Release TM1637 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 uint8_t **getKeys** ()
Get key states.

Protected Member Functions

- virtual void [writeDisplayControl](#) ()
Write display control register.
- virtual void [writeCommand](#) (uint8_t cmd)
Write command to [TM1637](#).
- virtual void [start](#) ()
Generate start condition.
- virtual void [stop](#) ()
Generate stop condition.
- virtual void [writeByte](#) (uint8_t data)
Write byte to [TM1637](#).
- virtual uint8_t [readByte](#) ()
Read byte from [TM1637](#).

Protected Attributes

- uint8_t [_clkPin](#)
Clock pin.
- uint8_t [_dioPin](#)
Data 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

[TM1637](#) class.

Definition at line 141 of file ErriezTM1637.h.

4.1.2 Constructor & Destructor Documentation

4.1.2.1 [TM1637::TM1637](#) (uint8_t *clkPin*, uint8_t *dioPin*, bool *displayOn* = true, uint8_t *brightness* = 5)

[TM1637](#) constructor.

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

Parameters

<i>clkPin</i>	TM1637 CLK pin.
<i>dioPin</i>	TM1637 DIO pin.
<i>displayOn</i>	true: Turn display on (default) false: Turn display off
<i>brightness</i>	Display brightness value 0..7

Definition at line 49 of file ErriezTM1637.cpp.

4.1.3 Member Function Documentation

4.1.3.1 `uint8_t TM1637::getKeys ()` `[virtual]`

Get key states.

Returns

0xFF: All keys up 0x00..0x0F: Key 0..15 down

Definition at line 191 of file ErriezTM1637.cpp.

4.1.3.2 `uint8_t TM1637::readByte ()` `[protected]`, `[virtual]`

Read byte from [TM1637](#).

Returns

8-bit value.

Definition at line 316 of file ErriezTM1637.cpp.

4.1.3.3 `void TM1637::setBrightness (uint8_t brightness)` `[virtual]`

Set brightness LED's.

Parameters

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

Definition at line 124 of file ErriezTM1637.cpp.

4.1.3.4 `void TM1637::writeByte (uint8_t data)` `[protected]`, `[virtual]`

Write byte to [TM1637](#).

Parameters

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

Definition at line 276 of file ErriezTM1637.cpp.

4.1.3.5 void TM1637::writeData (uint8_t *address*, uint8_t *data*) [virtual]

Write display register.

Parameters

<i>address</i>	Display address 0x00..0x05
<i>data</i>	Value 0x00..0xFF

Definition at line 151 of file ErriezTM1637.cpp.

4.1.3.6 void TM1637::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..0x05
<i>buf</i>	Buffer
<i>len</i>	Buffer length

Definition at line 172 of file ErriezTM1637.cpp.

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

- [ErriezTM1637.h](#)
- [ErriezTM1637.cpp](#)

Chapter 5

File Documentation

5.1 ErriezTM1637.cpp File Reference

[TM1637](#) library for Arduino.

```
#include "ErriezTM1637.h"
```

5.1.1 Detailed Description

[TM1637](#) library for Arduino.

Source: <https://github.com/Erriez/ErriezTM1637> Documentation: <https://erriez.github.io/ErriezTM1637>

5.2 ErriezTM1637.h File Reference

[TM1637](#) library for Arduino.

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

Classes

- class [TM1637](#)
[TM1637](#) class.

Macros

- `#define TM1637_CMD_DATA 0x40`
Display data command.
- `#define TM1637_CMD_CTRL 0x80`
Display control command.
- `#define TM1637_CMD_ADDR 0xc0`
Display address command.
- `#define TM1637_DATA_WRITE 0x00`
Write data.
- `#define TM1637_DATA_READ_KEYS 0x02`
Read keys.
- `#define TM1637_DATA_AUTO_INC_ADDR 0x00`
Auto increment address.
- `#define TM1637_DATA_FIXED_ADDR 0x04`
Fixed address.
- `#define TM1637_CTRL_PULSE_1_16 0x00`
Pulse width 1/16.
- `#define TM1637_CTRL_PULSE_2_16 0x01`
Pulse width 2/16.
- `#define TM1637_CTRL_PULSE_4_16 0x02`
Pulse width 4/16.
- `#define TM1637_CTRL_PULSE_10_16 0x03`
Pulse width 10/16.
- `#define TM1637_CTRL_PULSE_11_16 0x04`
Pulse width 11/16.
- `#define TM1637_CTRL_PULSE_12_16 0x05`
Pulse width 12/16.
- `#define TM1637_CTRL_PULSE_13_16 0x06`
Pulse width 13/16.
- `#define TM1637_CTRL_PULSE_14_16 0x07`
Pulse width 14/16.
- `#define TM1637_CTRL_DISPLAY_OFF 0x00`
Display off.
- `#define TM1637_CTRL_DISPLAY_ON 0x08`
Display on.
- `#define TM1637_NUM_GRIDS 6`
Number of grid registers.
- `#define TM1637_CLK_LOW() { digitalWrite(_clkPin, LOW); }`
CLK pin low.
- `#define TM1637_CLK_HIGH() { digitalWrite(_clkPin, HIGH); }`
CLK pin high.
- `#define TM1637_CLK_INPUT() { pinMode(_clkPin, INPUT); }`
CLK pin input.
- `#define TM1637_CLK_OUTPUT() { pinMode(_clkPin, OUTPUT); }`
CLK pin output.
- `#define TM1637_DIO_LOW() { digitalWrite(_dioPin, LOW); }`
DIO pin low.
- `#define TM1637_DIO_HIGH() { digitalWrite(_dioPin, HIGH); }`
DIO pin high.
- `#define TM1637_DIO_INPUT() { pinMode(_dioPin, INPUT); }`

- DIO pin input.*
 - `#define TM1637_DIO_OUTPUT() { pinMode(_dioPin, OUTPUT); }`
- DIO pin output.*
 - `#define TM1637_DIO_READ() (digitalRead(_dioPin))`
- DIO pin read.*
 - `#define TM1637_PIN_DELAY()`
- Delay between pin changes.*

5.2.1 Detailed Description

TM1637 library for Arduino.

Source: <https://github.com/Erriez/ErriezTM1637> Documentation: <https://erriez.github.io/ErriezTM1637>

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

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