

Erriez DHT22 library for Arduino
1.2.0

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Contents

- 1 Optimized TM1637 library for Arduino** **1**

- 2 Class Index** **5**
 - 2.1 Class List 5

- 3 File Index** **7**
 - 3.1 File List 7

- 4 Class Documentation** **9**
 - 4.1 TM1637 Class Reference 9
 - 4.1.1 Detailed Description 10
 - 4.1.2 Constructor & Destructor Documentation 10
 - 4.1.2.1 TM1637() 10
 - 4.1.3 Member Function Documentation 11
 - 4.1.3.1 getKeys() 11
 - 4.1.3.2 readByte() 11
 - 4.1.3.3 setBrightness() 11
 - 4.1.3.4 writeByte() 12
 - 4.1.3.5 writeData() [1/2] 12
 - 4.1.3.6 writeData() [2/2] 12

- 5 File Documentation** **15**
 - 5.1 src/ErriezTM1637.cpp File Reference 15
 - 5.1.1 Detailed Description 15
 - 5.2 src/ErriezTM1637.h File Reference 16
 - 5.2.1 Detailed Description 18

- Index** **19**

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

```
{c++}
// Include TM1637 library
#include <ErriezTM1637.h>

// Connect display pins to the Arduino DIGITAL pins
#define TM1637_CLK_PIN 2
#define TM1637_DIO_PIN 3

// Create tm1637 object
TM1637 tm1637(TM1637_CLK_PIN, TM1637_DIO_PIN);

void setup()
{
    // Initialize TM1637
    tm1637.begin();
}
```

Display on/off

```
{c++}
// Turn display off
tm1637.displayOff();

// Turn display on
tm1637.displayOn();
```

Turn all LED's off

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

Get keys

```
{c++}
// Get 8-bit key-scan
uint8_t keys = tm1637.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:
tm1637.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 TM1637
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:

TM1637	TM1637 class	9
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Chapter 3

File Index

3.1 File List

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

src/ ErriezTM1637.cpp	
TM1637 library for Arduino	15
src/ ErriezTM1637.h	
TM1637 library for Arduino	16

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 [getKey](#) ()
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::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 getKeys()

```
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 readByte()

```
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 setBrightness()

```
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 writeByte()

```
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 writeData() [1/2]

```
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 writeData() [2/2]

```
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:

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

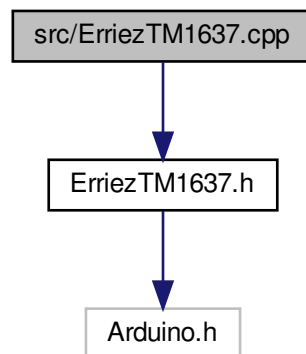
Chapter 5

File Documentation

5.1 src/ErriezTM1637.cpp File Reference

[TM1637](#) library for Arduino.

```
#include "ErriezTM1637.h"  
Include dependency graph for ErriezTM1637.cpp:
```



5.1.1 Detailed Description

[TM1637](#) library for Arduino.

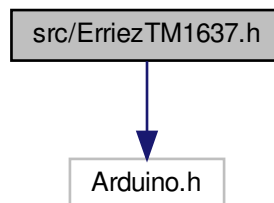
Source: <https://github.com/Erriez/ErriezTM1637> Documentation: <https://erriez.github.io/ErriezTM1637>

5.2 src/ErriezTM1637.h File Reference

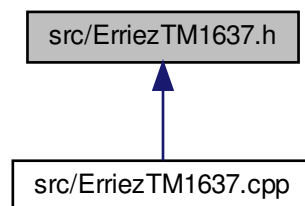
[TM1637](#) library for Arduino.

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

Include dependency graph for ErriezTM1637.h:



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



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

```

Index

getKeys

TM1637, [11](#)

readByte

TM1637, [11](#)

setBrightness

TM1637, [11](#)

src/ErriezTM1637.cpp, [15](#)

src/ErriezTM1637.h, [16](#)

TM1637, [9](#)

getKeys, [11](#)

readByte, [11](#)

setBrightness, [11](#)

TM1637, [10](#)

writeByte, [12](#)

writeData, [12](#)

writeByte

TM1637, [12](#)

writeData

TM1637, [12](#)