

PCF8574

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# Chapter 1

## Change Log PCF8574

All notable changes to this project will be documented in this file.

The format is based on [Keep a Changelog](#) and this project adheres to [Semantic Versioning](#).

### 1.1 [0.4.1] - 2023-09-23

- Update readme with advanced interrupts insights
  - kudos to ddowling for testing.
  - add example
- fix URL examples
- add Wire1 example (ESP32 + RP2040)

### 1.2 [0.4.0] - 2023-09-23

- refactor API, begin()
  - update readme.md
  - update examples
  - add examples ESP32 RP2040
  - minor edits
- 

### 1.3 [0.3.9] - 2023-09-23

- Add Wire1 support for ESP32
- update readme.md
- minor edits

## 1.4 [0.3.8] - 2023-02-04

- update readme.md
- update GitHub actions
- update license 2023

## 1.5 [0.3.7] - 2022-11-16

- fix #40 - add interrupt section to readme.md

## 1.6 [0.3.6] - 2022-10-19

- fix example PCF8574\_rotaryEncoder.ino
- add RP2040 to build-CI
- simplified changelog.md

## 1.7 [0.3.5] - 2022-06-17

- add select(), selectN(), selectNone() and selectAll() convenience wrappers

## 1.8 [0.3.4] - 2022-04-11

- add CHANGELOG.md
- fix `begin(int sda, int scl)` int parameters for ESP alike.

## 1.9 [0.3.3] - 2021-12-23

- update library.json, license, readme, minor edits

## 1.10 [0.3.2] - 2021-07-04

- fix #25 add setAddress()

## 1.11 [0.3.1] - 2021-04-23

- Fix for platformIO compatibility

## 1.12 [0.3.0] - 2021-01-03

- add multiWire support - inspired by mattbue - issue #14
- 

## 1.13 [0.2.4] - 2020-12-17

- fix #6 tag problem 0.2.3

## 1.14 [0.2.3] - 2020-12-14

- fix #6 readButton8 ambiguity
-

## 1.15 [0.2.2] - 2020-12-07

- add Arduino-ci + start unit test + `_wire->h` in [PCF8574.h](#)

## 1.16 [0.2.1] - 2020-06-19

- fix library.json

## 1.17 [0.2.0] - 2020-05-22

- `#pragma once`; refactor;
  - removed pre 1.0 support
  - added `begin(dsa, scl)` for ESP32
  - added `reverse()`
- 

## 1.18 [0.1.9] - 2017-02-27

- fix warning about return in `readButton8()`

## 1.19 [0.1.08] - 2016-05-20'

- Merged work of Septillion
- Fix/refactor `ButtonRead8()` - see <https://github.com/RobTillaart/Arduino/issues/38>
- missing `begin()` => mask parameter

## 1.20 [0.1.07] - 2016-05-02

- (manually merged) Septillion
- added `dataOut` so a `write()` doesn't read first, possibly corrupting a input pin;
- fixed shift comment, should read 1..7;
- added `begin()` to be sure it's in a known state, states could be different if uC is reset and the [PCF8574](#) isn't;
- added `buttonRead()` and `buttonRead8()` which only effect the output while reading

## 1.21 [0.1.06] - ??

- (intermediate) added defined errors + refactor rotate

## 1.22 [0.1.05] - 2016-04-30

- refactor, `+toggleMask`, `+rotLeft`, `+rotRight`

## 1.23 [0.1.04] - 2015-05-09

- removed ambiguity in `read8()`

## **1.24 [0.1.03] - 2015-03-02**

- address int -> uint8\_t

## **1.25 [0.1.02] - ?**

- replaced integers with uint8\_t to reduce footprint;
- added default value for shiftLeft() and shiftRight()
- renamed status() to lastError();

## **1.26 [0.1.01] - ?**

- added value(); returns last read 8 bit value (cached); value() does not always reflect the latest state of the pins!

## **1.27 [0.1.00] - 2013-02-02**

- initial version



# Chapter 2

## README

### 2.1 PCF8574

Arduino library for [PCF8574](#) - 8 channel I2C IO expander.

#### 2.1.1 Description

Related to the PCF8575 16 channel IO expander library <https://github.com/RobTillaart/PCF8575>  
This library gives easy control over the 8 pins of a [PCF8574](#) and PCF8574A chip. These chips are identical in behaviour although there are two distinct address ranges.

type	address-range	notes
<a href="#">PCF8574</a>	0x20 to 0x27	same range as PCF8575 !

| PCF8574A | 0x38 to 0x3F |

So you can connect up to 16 [PCF8574](#) on one I2C bus, giving access to  $16 \times 8 = 128$  IO lines. To maximize IO lines combine  $8 \times \text{PCF8575} + 8 \times \text{PCF8574A}$  giving  $128 + 64 = 192$  IO lines. Be sure to have a well dimensioned power supply.

The library allows to read and write both single pins or 8 pins at once. Furthermore some additional functions are implemented that are playful and useful.

**2.1.1.0.1 Interrupts intro** The [PCF8574](#) has an interrupt output line (INT) to notify an MCU that one of the input lines has changed. This can be used to prevent active polling of the [PCF8574](#), which can be more efficient.

From the datasheet:

*An interrupt is generated by any rising or falling edge of the port inputs in the input mode. After time, (Tiv), INT is valid. Resetting and reactivating the interrupt circuit is achieved when data on the port is **changed to the original setting** or data is **read from**, or **written to**, the port that generated the interrupt. Resetting occurs in the read mode at the acknowledge bit after the rising edge of the SCL signal, or in the write mode at the acknowledge bit after the high-to-low transition of the SCL signal.*

So there are three scenarios how the INT is reset.

1. pins revert to original state (lesser known).
2. read from the device (well known)
3. write to the device (well known)

This implies that polling the [PCF8574](#) can miss an INT in scenario 1. (see #48) In practice if you have faster polling than your signals changes this would not be a problem. E.g. tactile switches and a polling frequency  $> 100$  Hz will work.

**2.1.1.0.2 Interrupts library** The library cannot handle the [PCF8574](#) interrupts as it has no code for it. The user should catch the interrupt in his own code to set a flag and can use the library to see which line has changed. There are two examples to show how interrupts can be handled:

- **PCF8574\_interrupt.ino**
- **PCF8574\_rotaryEncoder.ino**

A more advanced interrupt handler would not set a boolean flag in the interrupt routine but increase a counter (uint8\_t or larger). Then it would be possible to see that:

1. an interrupt occurred. (counter > 0)
2. if one or more interrupts are not handled (counter > 1)

A minimal example that shows catching missed interrupts:

- **PCF8574\_interrupt\_advanced.ino**

**2.1.1.0.3 0.4.0 Breaking change** Version 0.4.0 introduced a breaking change. You cannot set the pins in **begin()** any more. This reduces the dependency of processor dependent Wire implementations. The user has to call **Wire.begin()** and can optionally set the Wire pins before calling **begin()**.

**2.1.1.0.4 Related** 16 bit port expanders

- [https://github.com/RobTillaart/MCP23017\\_RT](https://github.com/RobTillaart/MCP23017_RT)
- <https://github.com/RobTillaart/MCP23S17>
- <https://github.com/RobTillaart/PCF8575>

8 bit port expanders

- <https://github.com/RobTillaart/MCP23008>
- <https://github.com/RobTillaart/MCP23S08>
- <https://github.com/RobTillaart/PCF8574>

## 2.1.2 I2C Clock

Tested on UNO with **PCF8574\_performance** showed that the [PCF8574](#) still works at 500 KHz and failed at 600 KHz. These values are outside the specs of the datasheet so they are not recommended. However when performance is needed you can try to overclock the chip.

clock speed	Read	Write	Notes
100000	236	240	spec datasheet

| 200000 | 132 | 140 | | 300000 | 104 | 108 | | 400000 | 96 | 96 | max advised speed | | 500000 | 92 | 92 | not recommended | | 600000 | crash | crash |

## 2.1.3 Interface

```
#include "PCF8574.h"
```

**PCF8574\_INITIAL\_VALUE** is a define 0xFF that can be set compile time or before the include of "pcf8574.h" to overrule the default value used with the **begin()** call.

### 2.1.3.0.1 Constructor

- **PCF8574**(uint8\_t deviceAddress = 0x20, TwoWire \*wire = &Wire) Constructor with optional address, default 0x20, and the optional Wire interface as parameter.

- **bool begin(uint8\_t value = PCF8574\_INITIAL\_VALUE)** set the initial value (default 0xFF) for the pins and masks.
- **bool isConnected()** checks if the address set in the constructor or by **setAddress()** is visible on the I2C bus.
- **bool setAddress(const uint8\_t deviceAddress)** sets the device address after construction. Can be used to switch between [PCF8574](#) modules runtime. Note this corrupts internal buffered values, so one might need to call **read8()** and/or **write8()**. Returns true if address can be found on I2C bus.
- **uint8\_t getAddress()** Returns the device address.

#### 2.1.3.0.2 Read and Write

- **uint8\_t read8()** reads all 8 pins at once. This one does the actual reading.
- **uint8\_t read(uint8\_t pin)** reads a single pin; pin = 0..7
- **uint8\_t value()** returns the last read inputs again, as this information is buffered in the class this is faster than reread the pins.
- **void write8(const uint8\_t value)** writes all 8 pins at once. This one does the actual writing.
- **uint8\_t write(const uint8\_t pin, const uint8\_t value)** writes a single pin; pin = 0..7; value is HIGH(1) or LOW (0)
- **uint8\_t valueOut()** returns the last written data.

**2.1.3.0.3 Button** The **setButtonMask()** functions are to be used when you mix input and output on one IC. It does not change / affect the pins used for output by masking these. Typical usage is to call **setButtonMask()** once in setup as pins do not (often) change during program execution.

- **void setButtonMask(const uint8\_t mask)** sets the (bit) mask which lines are input.
- **uint8\_t getButtonMask()** returns the set buttonMask.
- **uint8\_t readButton8()** use the mask set by setButtonMask to select specific input pins.
- **uint8\_t readButton8(const uint8\_t mask)** use a specific mask to select specific input pins. Note this can be a subset of the pins set with **setButtonMask()** if one wants to process not all.
- **uint8\_t readButton(const uint8\_t pin)** read a single input pin.

Background - <https://github.com/RobTillaart/Arduino/issues/38>

#### 2.1.3.0.4 Special

- **void toggle(const uint8\_t pin)** toggles a single pin
- **void toggleMask(const uint8\_t mask = 0xFF)** toggles a selection of pins, if you want to invert all pins use 0xFF (default value).
- **void shiftRight(const uint8\_t n = 1)** shifts output channels n pins (default 1) pins right (e.g. LEDs ). Fills the higher lines with zero's.
- **void shiftLeft(const uint8\_t n = 1)** shifts output channels n pins (default 1) pins left (e.g. LEDs ). Fills the lower lines with zero's.
- **void rotateRight(const uint8\_t n = 1)** rotates output channels to right, moving lowest line to highest line.
- **void rotateLeft(const uint8\_t n = 1)** rotates output channels to left, moving highest line to lowest line.
- **void reverse()** reverse the "bit pattern" of the lines, swapping pin 7 with 0, 6 with 1, 5 with 2 etc.

#### 2.1.3.0.5 Select

Some convenience wrappers.

- **void select(const uint8\_t pin)** sets a single pin to HIGH, all others are set to LOW. If pin > 7 all pins are set to LOW. Can be used to select one of n devices.
- **void selectN(const uint8\_t pin)** sets pins 0..pin to HIGH, all others are set to LOW. If pin > 7 all pins are set to LOW. This can typical be used to implement a VU meter.
- **void selectNone()** sets all pins to LOW.
- **void selectAll()** sets all pins to HIGH.

#### 2.1.3.0.6 Miscellaneous

- **int lastError()** returns the last error from the lib. (see .h file).

### 2.1.4 Error codes

name	value	description
PCF8574_OK	0x00	no error
PCF8574_PIN_ERROR	0x81	pin number out of range
PCF8574_I2C_ERROR	0x82	I2C communication error

### 2.1.5 Operation

See examples.

It is advised to use pull-up or pull-down resistors so the lines have a defined state at startup.

### 2.1.6 Automated Documatation Creation

By the use of Doxygen it is able to run an automated documentation build.

#### 2.1.6.1 Installation

To be able to run the doxygen build you need to install doxygen

```
sudo apt install doxygen
```

To be able to create PDF Output you need to install LaTeX.

```
sudo apt install texlive-full
```

### 2.1.7 Usage

To build the documentation you have to use the following comand on the commandline

```
doxygen Doxyfile
```

After that you should be able to create the PDF by:

```
cd doxygen/latex
```

```
make
```

After that you will find the **refman.pdf** in the `doxygen/latex` folder.

Have fun.

### 2.1.8 Future

#### 2.1.8.0.1 Must

- keep in sync with PCF8575 (as far as meaningful)

#### 2.1.8.0.2 Should

#### 2.1.8.0.3 Could

- move code to .cpp

#### 2.1.8.0.4 Wont

### 2.1.9 Support

If you appreciate my libraries, you can support the development and maintenance. Improve the quality of the libraries by providing issues and Pull Requests, or donate through PayPal or GitHub sponsors.

Thank you,



## Chapter 3

# Class Index

### 3.1 Class List

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

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## Chapter 4

# File Index

### 4.1 File List

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

[PCF8574.cpp](#)

    Arduino library for [PCF8574](#) - 8 channel I2C IO expander . . . . . [23](#)

**PCF8574.h** . . . . . **??**



## Chapter 5

# Class Documentation

### 5.1 PCF8574 Class Reference

#### Public Member Functions

- **PCF8574** (const uint8\_t deviceAddress=0x20, TwoWire \*wire=&Wire)  
*Construct a new **PCF8574::PCF8574** object.*
- bool **begin** (uint8\_t value=PCF8574\_INITIAL\_VALUE)  
*init **PCF8574** instance*
- bool **isConnected** ()  
*check if device is connected*
- bool **setAddress** (const uint8\_t deviceAddress)  
*set address of **PCF8574** device*
- uint8\_t **getAddress** () const  
*getter for I2C address of pcf7485 device should be in the range of 0x20...0x27*
- uint8\_t **read8** ()  
*read all 8 bit at once from **PCF8574***
- uint8\_t **read** (const uint8\_t pin)  
*read one bit from **PCF8574** device*
- uint8\_t **value** () const  
*returns the last read inputs again, as this information is buffered in the class this is faster than re-read the pins.*
- void **write8** (const uint8\_t value)  
*write all 8 bit at once to **PCF8574** device*
- void **write** (const uint8\_t pin, const uint8\_t value)  
*writes a single pin; pin = 0..7.*
- uint8\_t **valueOut** () const  
*returns the last written data.*
- uint8\_t **readButton8** ()  
*returns the set buttonMask.*
- uint8\_t **readButton8** (const uint8\_t mask)  
*read Button mask.*
- uint8\_t **readButton** (const uint8\_t pin)  
*read button read a single input pin.*
- void **setButtonMask** (const uint8\_t mask)  
*sets the bit mask which lines are input.*
- uint8\_t **getButtonMask** ()  
*returns the internal button mask member*
- void **toggle** (const uint8\_t pin)  
*toggle one bit on **PCF8574** device*

- void `toggleMask` (const uint8\_t mask=0xFF)  
*toggles a selection of pins, if you want to invert all pins use 0xFF (default value).*
- void `shiftRight` (const uint8\_t n=1)  
*shifts output channels n pins (default 1) pins right (e.g. LEDs ). Fills the higher lines with zero's.*
- void `shiftLeft` (const uint8\_t n=1)  
*shifts output channels n pins (default 1) pins left (e.g. LEDs ). Fills the lower lines with zero's*
- void `rotateRight` (const uint8\_t n=1)  
*rotates output channels to right, moving lowest line to highest line.*
- void `rotateLeft` (const uint8\_t n=1)  
*rotates output channels to left, moving highest line to lowest line.*
- void `reverse` ()  
*reverse the "bit pattern" of the lines, swapping pin 7 with 0, 6 with 1, 5 with 2 etc.*
- void `select` (const uint8\_t pin)  
*select sets the specified pin pin to High, all others set to Low. If pin > 7 all pins are set to LOW.*
- void `selectN` (const uint8\_t pin)  
*select sets the pins from 0...pin to High, all others set to Low. If pin > 7 all pins are set to LOW.*
- void `selectNone` ()  
*sets all pins to LOW.*
- void `selectAll` ()  
*sets all pins to HIGH.*
- int `lastError` ()  
*returns the last error from the lib (see .h file).*

## 5.1.1 Constructor & Destructor Documentation

### 5.1.1.1 PCF8574()

```
PCF8574::PCF8574 (
    const uint8_t deviceAddress = 0x20,
    TwoWire * wire = &Wire ) [explicit]
```

Construct a new `PCF8574::PCF8574` object.

#### Parameters

<i>deviceAddress</i>	optional address of I2C device; default = 0x20;
<i>wire</i>	optional address of Wire instance; default = &Wire;

## 5.1.2 Member Function Documentation

### 5.1.2.1 begin()

```
bool PCF8574::begin (
    uint8_t value = PCF8574_INITIAL_VALUE )
```

init `PCF8574` instance

#### Parameters

<i>value</i>	optional init value to write; default = 0xFF;
--------------	---

**Returns**

true  
false

**5.1.2.2 getAddress()**

```
uint8_t PCF8574::getAddress ( ) const [inline]
```

getter for I2C address of pcf7485 device should be in the range of 0x20...0x27

**Returns**

uint8\_t address

**5.1.2.3 getButtonMask()**

```
uint8_t PCF8574::getButtonMask ( ) [inline]
```

returns the internal button mask member

**Returns**

uint8\_t the mask for input lines

**5.1.2.4 isConnected()**

```
bool PCF8574::isConnected ( )
```

check if device is connected

**Returns**

true  
false

**5.1.2.5 lastError()**

```
int PCF8574::lastError ( )
```

returns the last error from the lib (see .h file).

**Returns**

int error value to return

**5.1.2.6 read()**

```
uint8_t PCF8574::read (
    const uint8_t pin )
```

read one bit from [PCF8574](#) device

**Parameters**

<i>pin</i>	pin to read (0...7)
------------	---------------------

**Returns**

uint8\_t value

**5.1.2.7 read8()**

```
uint8_t PCF8574::read8 ( )
```

read all 8 bit at once from [PCF8574](#)

**Returns**

uint8\_t value read from device

**5.1.2.8 readButton()**

```
uint8_t PCF8574::readButton (
    const uint8_t pin )
```

read button read a single input pin.

**Parameters**

<i>pin</i>	pin number to be read
------------	-----------------------

**Returns**

uint8\_t value read from pin

**5.1.2.9 readButton8() [1/2]**

```
uint8_t PCF8574::readButton8 ( ) [inline]
```

returns the set buttonMask.

**Returns**

uint8\_t the mask for input lines

**5.1.2.10 readButton8() [2/2]**

```
uint8_t PCF8574::readButton8 (
    const uint8_t mask )
```

read Button mask.

**Parameters**

<i>mask</i>	use the mask set by setButtonMask to select specific input pins.
-------------	--

**Returns**

\* uint8\_t

**5.1.2.11 rotateLeft()**

```
void PCF8574::rotateLeft (
```

```
const uint8_t n = 1 )
```

rotates output channels to left, moving highest line to lowest line.

#### Parameters

<i>n</i>	number of moves
----------	-----------------

#### 5.1.2.12 rotateRight()

```
void PCF8574::rotateRight (
    const uint8_t n = 1 )
```

rotates output channels to right, moving lowest line to highest line.

#### Parameters

<i>n</i>	number of moves
----------	-----------------

#### 5.1.2.13 select()

```
void PCF8574::select (
    const uint8_t pin )
```

select sets the specified pin *pin* to High, all others set to Low. If *pin* > 7 all pins are set to LOW.

#### Parameters

<i>pin</i>	pin which should be set to 1
------------	------------------------------

#### 5.1.2.14 selectN()

```
void PCF8574::selectN (
    const uint8_t pin )
```

select sets the pins from 0...*pin* to High, all others set to Low. If *pin* > 7 all pins are set to LOW.

#### Parameters

<i>pin</i>	pin up to which should be set to 1
------------	------------------------------------

#### 5.1.2.15 setAddress()

```
bool PCF8574::setAddress (
    const uint8_t deviceAddress )
```

set address of [PCF8574](#) device

#### Parameters

<i>deviceAddress</i>	I2C address; possible values 0x20...0x27
----------------------	--

**Returns**

true  
false

**5.1.2.16 setButtonMask()**

```
void PCF8574::setButtonMask (
    const uint8_t mask ) [inline]
```

sets the bit mask which lines are input.

**Parameters**

<i>mask</i>	bit mask of inputs
-------------	--------------------

**5.1.2.17 shiftLeft()**

```
void PCF8574::shiftLeft (
    const uint8_t n = 1 )
```

shifts output channels n pins (default 1) pins left (e.g. LEDs ). Fills the lower lines with zero's

**Parameters**

<i>n</i>	number of shifts
----------	------------------

**5.1.2.18 shiftRight()**

```
void PCF8574::shiftRight (
    const uint8_t n = 1 )
```

shifts output channels n pins (default 1) pins right (e.g. LEDs ). Fills the higher lines with zero's.

**Parameters**

<i>n</i>	number of shifts
----------	------------------

**5.1.2.19 toggle()**

```
void PCF8574::toggle (
    const uint8_t pin )
```

toggle one bit on [PCF8574](#) device

**Parameters**

<i>pin</i>	pin number for write (0...7)
------------	------------------------------

**5.1.2.20 toggleMask()**

```
void PCF8574::toggleMask (
    const uint8_t mask = 0xFF )
```



toggles a selection of pins, if you want to invert all pins use 0xFF (default value).

#### Parameters

<i>mask</i>	
-------------	--

#### 5.1.2.21 value()

```
uint8_t PCF8574::value ( ) const [inline]
```

returns the last read inputs again, as this information is buffered in the class this is faster than re-read the pins.

#### Returns

uint8\_t internal member \_dataIn

#### 5.1.2.22 valueOut()

```
uint8_t PCF8574::valueOut ( ) const [inline]
```

returns the last written data.

#### Returns

uint8\_t internal member \_dataOut

#### 5.1.2.23 write()

```
void PCF8574::write (
    const uint8_t pin,
    const uint8_t value )
```

writes a single pin; pin = 0..7.

#### Parameters

<i>pin</i>	pin number for write (0...7)
<i>value</i>	value to write, HIGH(1) or LOW (0)

#### 5.1.2.24 write8()

```
void PCF8574::write8 (
    const uint8_t value )
```

write all 8 bit at once to [PCF8574](#) device

#### Parameters

<i>value</i>	to write
--------------	----------

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

- [PCF8574.h](#)
- [PCF8574.cpp](#)



## Chapter 6

# File Documentation

### 6.1 PCF8574.cpp File Reference

Arduino library for [PCF8574](#) - 8 channel I2C IO expander.  
`#include "PCF8574.h"`

#### 6.1.1 Detailed Description

Arduino library for [PCF8574](#) - 8 channel I2C IO expander.

**Author**

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**Date**

02-febr-2013

**Version**

0.4.1

**See also**

<https://github.com/RobTillaart/PCF8574>

<http://forum.arduino.cc/index.php?topic=184800>



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