Erriez Oregon THN128 433MHz temperature sensor library for Arduino

1.0.0

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Contents

Chapter 1

Oregon THN128 433MHz temperature sensor transmit/receive library for Arduino

This is a transmit/receive library Arduino library with the Oregon THN128 433MHz wireless protocol.

Tested on an Arduino UNO and pro-micro 3.3V 8MHz.

Transmit / receive hardware

This library is optimized for low-power Arduino ATMega328 microcontroller. Other targets are not supported.

Temperature transmitter on the left breadboard:

- Pro-Mini 3V3 8MHz (with FTDI232 - USB serial interface).
- Genuine DS18B20 temperature sensor. STX802 low-power 433MHz transmitter.

Receiver on on the right breadboard:

- SRX882 low-power 433MHz receiver.
- SSD1306 I2C 128x64 OLED display.
- Pro-Mini 3V3 8MHz (with FTDI232 - USB serial interface).

Hardware notes

- 1 to 3 temperature transmitters are supported, similar to the original Oregon THN128 temperature transmitters.
- Check `list of counterfeit DS18B20 chips`, because this makes a huge difference in accuracy and read errors at 3.3V. Many DS18B20 chips from Aliexpress are counterfeit and won't work reliable at voltages below 3.3V.
- `NiceRF Wireless Technology Co., Ltd.` sells high quality 433MHz transmit (STX802) and receiver modules (STX882) with a good range.
- The Pro-Mini 3V3 8MHz is a good low-power Arduino boards after desoldering the power LED. A transmitter with 18650 battery can operate for at least 6 months with `LowPower.h` functionality implemented. (By sending the temperature every 30 seconds)
- Changing the BOD (Brown Out Detection) fuse to 1.8V allows operation between 1.8 and 4.2V 18650 battery.
- A 18650 battery (with protection circuit) should be connected directly to the VCC pin (not VIN).
- The voltage regulator can be desoldered from the pro-micro board when not used for more power reduction.

Oregon Protocol

A packet is sent twice:

Data (see header file `ErriezOregonTHN128Receive.h`):

Example low power receive

```
{c++}
#include <LowPower.h>
#include <ErriezOregonTHN128Receive.h>

// RF pin 2 (INT0) or pin 3 (INT1) defines
#define RF_RX_PIN     2


void printReceivedData(OregonTHN128Data_t *data)
{
    bool negativeTemperature = false;
    static uint32_t rxCount = 0;
    int16_t tempAbs;
    char msg[80];

    // Convert to absolute temperature
    tempAbs = data->temperature;
    if (tempAbs < 0) {
        negativeTemperature = true;
        tempAbs *= -1;
    }
    snprintf(msg, sizeof(msg), "RX %lu: Rol: %d, Channel %d, Temp: %s%d.%d, Low batt: %d (0x%08lx)",
             rxCount++,
             data->rollingAddress, data->channel,
             (negativeTemperature ? "-" : ""), (tempAbs / 10), (tempAbs % 10), data->lowBattery,
             data->rawData);
    Serial.println(msg);
}

void setup()
{
    // Initialize serial port
    Serial.begin(115200);
    Serial.println(F("Oregon THN128 433MHz temperature receive"));

    // Turn LED on
    pinMode(LED_BUILTIN, OUTPUT);
    digitalWrite(LED_BUILTIN, HIGH);

    // Initialize receiver
    OregonTHN128_RxBegin(RF_RX_PIN);
}

void loop()
{
    OregonTHN128Data_t data;

    // Check temperature received
    if (OregonTHN128_Available()) {
        digitalWrite(LED_BUILTIN, LOW);

        // Read temperature
        OregonTHN128_Read(&data);

        // Print received data
        printReceivedData(&data);

        // Wait ~30 seconds before receiving next temperature
        Serial.flush();
        LowPower.powerDown(SLEEP_8S, ADC_OFF, BOD_OFF);
        LowPower.powerDown(SLEEP_8S, ADC_OFF, BOD_OFF);
        LowPower.powerDown(SLEEP_8S, ADC_OFF, BOD_OFF);
        LowPower.powerDown(SLEEP_2S, ADC_OFF, BOD_OFF);

        digitalWrite(LED_BUILTIN, HIGH);

        // Enable receive
        OregonTHN128_RxEnable();
    }
}
```

Example low power transmit

```
{c++}
#include <LowPower.h>
#include <ErriezOregonTHN128Transmit.h>

// Pin defines
#define RF_TX_PIN           9

OregonTHN128Data_t data = {
    .rawData = 0,           // Raw data filled in by library
    .rollingAddress = 5,    // Rolling address 0..7
    .channel = 1,           // Channel 1, 2 or 3
    .temperature = 0,       // Temperature -99.9 .. 99.9 multiplied by 10
    .lowBattery = false,    // Low battery true or false
};

#ifdef __cplusplus
extern "C" {
#endif

// Function is called from library
void delay100ms()
{
    Serial.flush();
    digitalWrite(LED_BUILTIN, HIGH);
    LowPower.powerDown(SLEEP_60MS, ADC_OFF, BOD_OFF);
    digitalWrite(LED_BUILTIN, LOW);
    LowPower.powerDown(SLEEP_30MS, ADC_OFF, BOD_OFF);
}

#ifdef __cplusplus
}
#endif

void setup()
{
    // Initialize pins
    OregonTHN128_TxBegin(RF_TX_PIN);
}

void loop()
{
    // Set temperature
    data.temperature = 123; //12.3‘C

    // Send temperature
    OregonTHN128_Transmit(&data);

    // Wait some time
    // Wait ~30 seconds before sending next temperature
    Serial.flush();
    LowPower.powerDown(SLEEP_8S, ADC_OFF, BOD_OFF);
    LowPower.powerDown(SLEEP_8S, ADC_OFF, BOD_OFF);
    LowPower.powerDown(SLEEP_8S, ADC_OFF, BOD_OFF);
    LowPower.powerDown(SLEEP_4S, ADC_OFF, BOD_OFF);
}
```

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 OregonTHN128Data_t Struct Reference

Data structure.

```
#include <ErriezOregonTHN128.h>
```

Public Attributes

- uint32_t rawData
- uint8_t rollingAddress
- uint8_t channel
- int16_t temperature
- bool lowBattery

4.1.1 Detailed Description

Data structure.

Definition at line 63 of file ErriezOregonTHN128.h.

4.1.2 Member Data Documentation

4.1.2.1 channel

```
uint8_t OregonTHN128Data_t::channel
```

Channel

Definition at line 66 of file ErriezOregonTHN128.h.

4.1.2.2 lowBattery

```
bool OregonTHN128Data_t::lowBattery
```

Low battery indication

Definition at line 68 of file ErriezOregonTHN128.h.

4.1.2.3 rawData

```
uint32_t OregonTHN128Data_t::rawData
```

Raw data

Definition at line 64 of file ErriezOregonTHN128.h.

4.1.2.4 rollingAddress

```
uint8_t OregonTHN128Data_t::rollingAddress
```

Rolling address

Definition at line 65 of file ErriezOregonTHN128.h.

4.1.2.5 temperature

```
int16_t OregonTHN128Data_t::temperature
```

Temperature

Definition at line 67 of file ErriezOregonTHN128.h.

The documentation for this struct was generated from the following file:

- src/ErriezOregonTHN128.h

Chapter 5

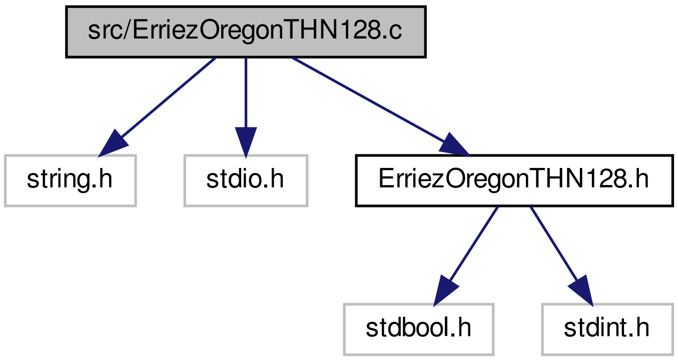
File Documentation

5.1 src/ErriezOregonTHN128.c File Reference

Oregon THN128 433MHz temperature transmit/receive library for Arduino.

```
#include <string.h>
#include <stdio.h>
#include "ErriezOregonTHN128.h"
```

Include dependency graph for ErriezOregonTHN128.c:



Macros

- #define **SET_ROL_ADDR**(x) (((x) & 0x07) << 0)
- #define **GET_ROL_ADDR**(x) (((x) & 0x07) << 0)
- #define **SET_CHANNEL**(x) ((((x) - 1) & 0x03) << 6)
- #define **GET_CHANNEL**(x) ((((x) >> 6) & 0x03) + 1)
- #define **SET_TEMP**(x)
- #define **GET_TEMP**(x)
- #define **SIGN_BIT** (1UL << 21)
- #define **LOW_BAT_BIT** (1UL << 23)
- #define **SET_CRC**(x) ((uint32_t)(x) << 24)
- #define **GET_CRC**(x) ((x) >> 24)

Functions

- bool OregonTHN128_CheckCRC (uint32_t rawData)
  Verify checksum.
- void OregonTHN128_TempToString (char ∗temperatureStr, uint8_t temperatureStrLen, int16_t temperature)
  Convert temperature to string.
- uint32_t OregonTHN128_DataToRaw (OregonTHN128Data_t ∗data)
  Convert data structure to 32-bit raw data.
- bool OregonTHN128_RawToData (uint32_t rawData, OregonTHN128Data_t ∗data)
  Cnonvert 32-bit raw data to OregonTHN128Data_t structure.

5.1.1 Detailed Description

Oregon THN128 433MHz temperature transmit/receive library for Arduino.

Source: `https://github.com/Erriez/ErriezOregonTHN128` Documentation: `https://erriez.↩ github.io/ErriezOregonTHN128`

5.1.2 Macro Definition Documentation

5.1.2.1 GET_TEMP

```
#define GET_TEMP(
               x )
```

Value:

```
(((((x) >> 16) & 0x0f) * 100) + \
                            ((((x) >> 12) & 0x0f) * 10) + \
                            (((x) >> 8) & 0x0f))
```

Definition at line 47 of file ErriezOregonTHN128.c.

5.1.2.2 SET_TEMP

```
#define SET_TEMP(
               x )
```

Value:

```
((((((uint32_t)(x) / 100) % 10)) << 16) | \
                            ((((uint32_t)(x) / 10) % 10) << 12) | \
                            (((x) % 10) << 8))
```

Definition at line 44 of file ErriezOregonTHN128.c.

5.1.3 Function Documentation

5.1.3.1 OregonTHN128_CheckCRC()

```
bool OregonTHN128_CheckCRC (
              uint32_t rawData )
```

Verify checksum.

Parameters

rawData	32-bit raw data input

Returns

true: Success, false: error

Definition at line 86 of file ErriezOregonTHN128.c.

5.1.3.2 OregonTHN128_DataToRaw()

```
uint32_t OregonTHN128_DataToRaw (
            OregonTHN128Data_t * data )
```

Convert data structure to 32-bit raw data.

Parameters

data	Input

Returns

Output

Definition at line 126 of file ErriezOregonTHN128.c.

5.1.3.3 OregonTHN128_RawToData()

```
bool OregonTHN128_RawToData (
            uint32_t rawData,
            OregonTHN128Data_t * data )
```

Cnonvert 32-bit raw data to OregonTHN128Data_t structure.

Parameters

rawData	32-bit input
data	output

Returns

CRC true: Success, false: error

Definition at line 165 of file ErriezOregonTHN128.c.

5.1.3.4 OregonTHN128_TempToString()

```
void OregonTHN128_TempToString (
             char * temperatureStr,
             uint8_t temperatureStrLen,
             int16_t temperature )
```

Convert temperature to string.

Parameters

temperatureStr	Character buffer
temperatureStrLen	Size of character buffer
temperature	Input temperature

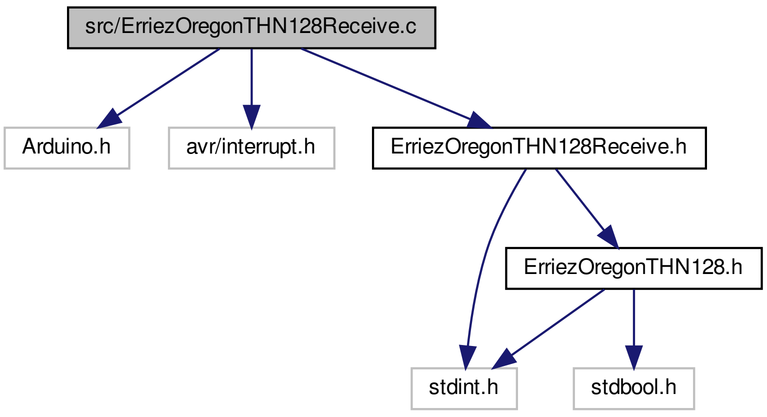
Definition at line 103 of file ErriezOregonTHN128.c.

5.2 src/ErriezOregonTHN128Receive.c File Reference

Oregon THN128 433MHz temperature transmit/receive library for Arduino.

```
#include <Arduino.h>
#include <avr/interrupt.h>
#include "ErriezOregonTHN128Receive.h"
```

Include dependency graph for ErriezOregonTHN128Receive.c:



Enumerations

- enum **RxState_t** {
  StateSearchSync = 0, **StateMid0** = 1, **StateMid1** = 2, **StateEnd** = 3,
  StateRxComplete = 4 }

Functions

- void **rfPinChange** (void)
- void **OregonTHN128_RxBegin** (uint8_t extIntPin)
- void **OregonTHN128_RxEnable** ()
- void **OregonTHN128_RxDisable** ()
- bool **OregonTHN128_Available** ()
- bool **OregonTHN128_Read** (OregonTHN128Data_t ∗data)

5.2.1 Detailed Description

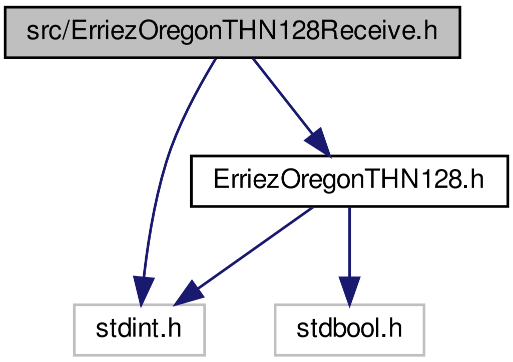
Oregon THN128 433MHz temperature transmit/receive library for Arduino.

Source: `https://github.com/Erriez/ErriezOregonTHN128` Documentation: `https://erriez.github.io/ErriezOregonTHN128`

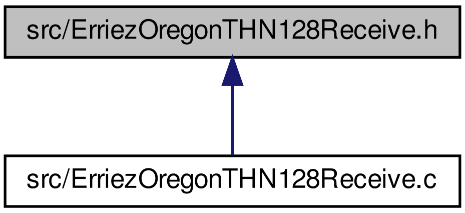
5.3 src/ErriezOregonTHN128Receive.h File Reference

Oregon THN128 433MHz temperature receive library for Arduino.

```
#include <stdint.h>
#include "ErriezOregonTHN128.h"
```
Include dependency graph for ErriezOregonTHN128Receive.h:



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


src/ErriezOregonTHN128Receive.h
src/ErriezOregonTHN128Receive.c

Functions

- void **OregonTHN128_RxBegin** (uint8_t extIntPin)
- void **OregonTHN128_RxEnable** ()
- void **OregonTHN128_RxDisable** ()
- bool **OregonTHN128_Available** (void)
- uint32_t **OregonTHN128_GetRawData** ()
- bool **OregonTHN128_Read** (OregonTHN128Data_t ∗data)

5.3.1 Detailed Description

Oregon THN128 433MHz temperature receive library for Arduino.

Source: `https://github.com/Erriez/ErriezOregonTHN128` Documentation: `https://erriez.github.io/ErriezOregonTHN128`

Protocol:

Transmit temperature twice every 30 seconds:

Bit: 0 7 0 7 0 7 0 7 +-—+-—+---—+---—+----—+----—+ +-—+-—+----—+– |PREA|SYNC|Byte 0|Byte 1|Byte 2|Byte 3| |PREA|SYNC|Byte 0| ... +-—+-—+---—+----—+----—+----—+-—/\/-—+-—+-—+---—+– |<-------------— 144ms ------------>|<- 100ms ->| 30 sec

Logic '0': Logic '1': +-—+ +-—+ | | +-—+ +-—+ 1400 1500 1500 1400 (us)

PREA: Preamble 12x logic '1', 3000us low

SYNC: +-------+ | |

- +-------+ 5500us 5500us

Byte 0:

- Bit 0..3: Rolling address (Random value after power cycle)
- Bit 6..7: Channel: (0 = channel 1 .. 2 = channel 3)

Byte 1:

- Bit 0..3: TH3
- Bit 4..7: TH2

Byte 2:

- Bit 0..3: TH1
- Bit 5: Sign
- Bit 7: Low battery

Byte 3:

- Bit 0..7: CRC

Example: Rolling address = 5, channel = 1, temperature = 27.8 ‘C, low battery = false TH1 = 2, TH2 = 7, TH3 = 8: Byte 0: 0x05 Byte 1: 0x78 Byte 2: 0x02 Byte 3: 0x7f

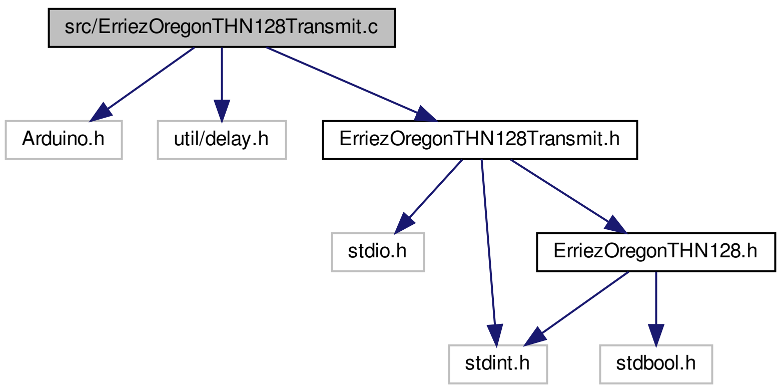
Bits in time: PRE=1 S B0=0x05 B1=0x78 B2=0x02 B3=0x7f 111111111111 S 10100000 00011110 01000000 11111110

5.4 src/ErriezOregonTHN128Transmit.c File Reference

Oregon THN128 433MHz temperature transmit library for Arduino.

```
#include <Arduino.h>
#include <util/delay.h>
#include "ErriezOregonTHN128Transmit.h"
```

Include dependency graph for ErriezOregonTHN128Transmit.c:



Macros

- #define **RF_TX_PIN_INIT**(rfTxPin)
- #define **RF_TX_PIN_DISABLE**()
- #define **RF_TX_PIN_HIGH**() { ∗portOutputRegister(_rfTxPort) |= _rfTxBit; }
- #define **RF_TX_PIN_LOW**() { ∗portOutputRegister(_rfTxPort) &= ∼_rfTxBit; }

Functions

- void delay100ms (void)

  Transmit sync pulse.
- void OregonTHN128_TxBegin (uint8_t rfTxPin)

  Transmit begin.
- void OregonTHN128_TxEnd (void)

  Disable transmit.
- void OregonTHN128_TxRawData (uint32_t rawData)

  Transmit data.
- void OregonTHN128_Transmit (OregonTHN128Data_t ∗data)

  Transmit Transmit data.

5.4.1 Detailed Description

Oregon THN128 433MHz temperature transmit library for Arduino.

Source: https://github.com/Erriez/ErriezOregonTHN128 Documentation: https://erriez.↵github.io/ErriezOregonTHN128

5.4.2 Macro Definition Documentation

5.4.2.1 RF_TX_PIN_DISABLE

```
#define RF_TX_PIN_DISABLE( )
```

Value:

```
{           \
    if ((_rfTxPort >= 0) && (_rfTxBit >= 0)) {      \
        *portModeRegister(_rfTxPort) &= ~_rfTxBit;  \
    }                                               \
}
```

5.4.2.2 RF_TX_PIN_INIT

```
#define RF_TX_PIN_INIT(
              rfTxPin )
```

Value:

```
{           \
    _rfTxPort = digitalPinToPort(rfTxPin);          \
    _rfTxBit = digitalPinToBitMask(rfTxPin);        \
    *portModeRegister(_rfTxPort) |= _rfTxBit;       \
}
```

5.4.3 Function Documentation

5.4.3.1 OregonTHN128_Transmit()

```
void OregonTHN128_Transmit (
             OregonTHN128Data_t * data )
```

Transmit Transmit data.

Parameters

data	Oregon THN128 input structure

Definition at line 195 of file ErriezOregonTHN128Transmit.c.

5.4.3.2 OregonTHN128_TxBegin()

```
void OregonTHN128_TxBegin (
             uint8_t rfTxPin )
```

Transmit begin.

Parameters

rfTxPin	Arduino transmit pin

Definition at line 138 of file ErriezOregonTHN128Transmit.c.

5.4.3.3 OregonTHN128_TxEnd()

```
void OregonTHN128_TxEnd (
             void  )
```

Disable transmit.

Set transmit pin to input

Definition at line 149 of file ErriezOregonTHN128Transmit.c.

5.4.3.4 OregonTHN128_TxRawData()

```
void OregonTHN128_TxRawData (
             uint32_t rawData )
```

Transmit data.

Parameters

rawData	32-bit raw data input

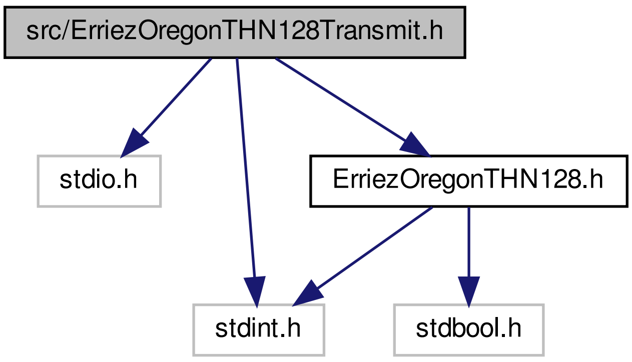
Definition at line 160 of file ErriezOregonTHN128Transmit.c.

5.5 src/ErriezOregonTHN128Transmit.h File Reference

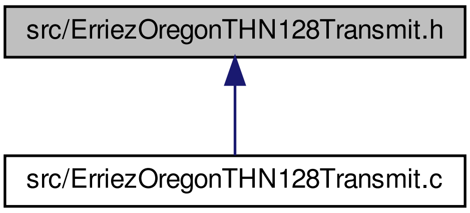
Oregon THN128 433MHz temperature transmit library for Arduino.

```
#include <stdio.h>
#include <stdint.h>
#include "ErriezOregonTHN128.h"
```

Include dependency graph for ErriezOregonTHN128Transmit.h:



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


src/ErriezOregonTHN128Transmit.h
src/ErriezOregonTHN128Transmit.c

Functions

- void OregonTHN128_TxBegin (uint8_t rfTxPin)

  Transmit begin.
- void OregonTHN128_TxRawData (uint32_t rawData)

  Transmit data.
- void OregonTHN128_Transmit (OregonTHN128Data_t ∗data)

  Transmit Transmit data.

5.5.1 Detailed Description

Oregon THN128 433MHz temperature transmit library for Arduino.

Source: `https://github.com/Erriez/ErriezOregonTHN128` Documentation: `https://erriez.↩ github.io/ErriezOregonTHN128`

5.5.2 Function Documentation

5.5.2.1 OregonTHN128_Transmit()

```
void OregonTHN128_Transmit (
             OregonTHN128Data_t ∗ data )
```

Transmit Transmit data.

Parameters

data	Oregon THN128 input structure

Definition at line 195 of file ErriezOregonTHN128Transmit.c.

5.5.2.2 OregonTHN128_TxBegin()

```
void OregonTHN128_TxBegin (
             uint8_t rfTxPin )
```

Transmit begin.

Parameters

rfTxPin	Arduino transmit pin

Definition at line 138 of file ErriezOregonTHN128Transmit.c.

5.5.2.3 OregonTHN128_TxRawData()

```
void OregonTHN128_TxRawData (
             uint32_t rawData )
```

Transmit data.

Parameters

rawData	32-bit raw data input

Definition at line 160 of file ErriezOregonTHN128Transmit.c.

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