

# FRA222 Microcontroller interface

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QEI

DEBUGGER TOOL


A solid orange horizontal bar spanning the width of the slide, located at the bottom.

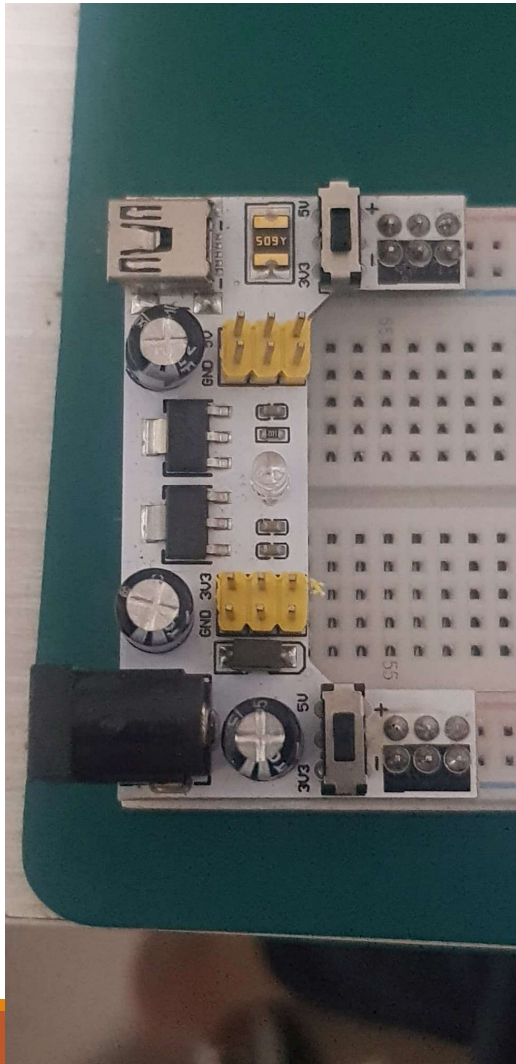
# Summary

---

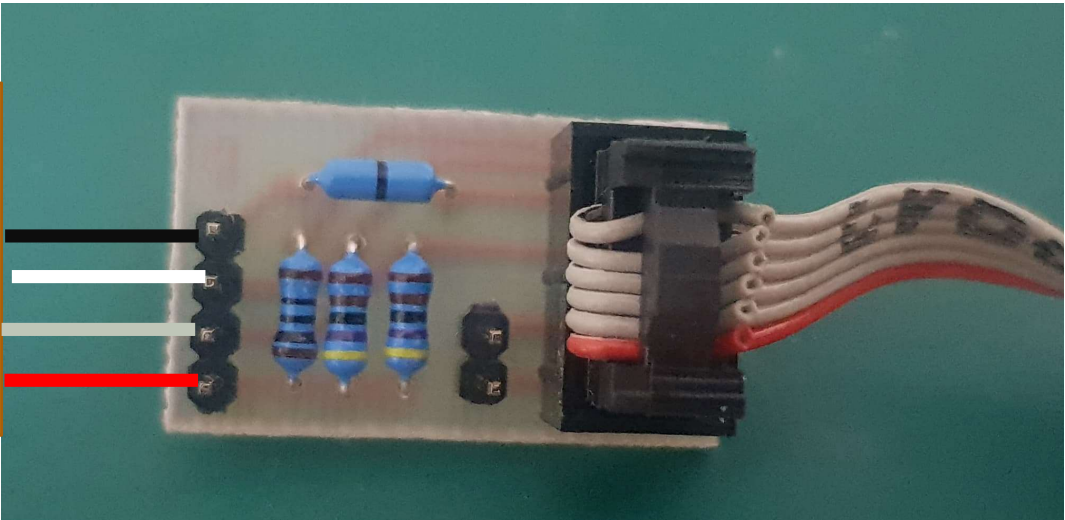
# Today Plan

---

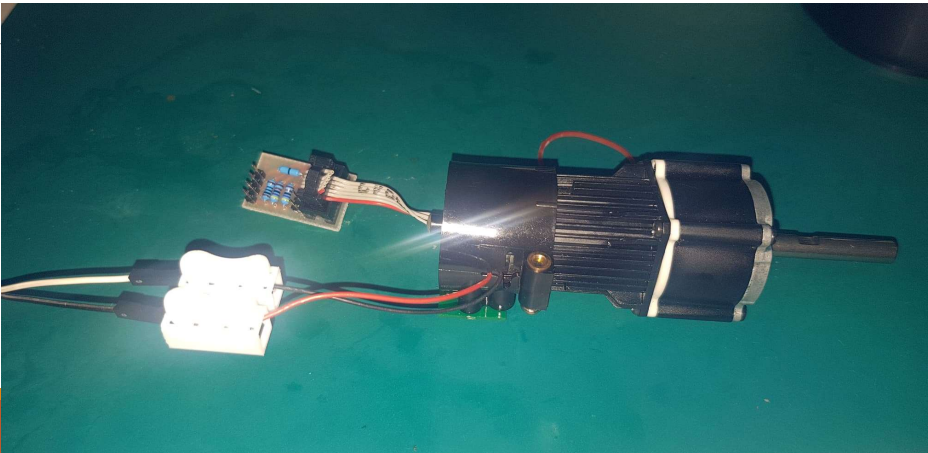
- QEI – Read Position
  - printf with SWD
  - QEI – Calculate angular velocity
  - STM32 Cube Monitor
- 
- A solid orange horizontal bar spanning the width of the slide, located at the bottom.



{From  
Nucleo}  
GND  
[A] PA6  
[B] PA7  
+5V



QEI  
12 ใบพัด  
64 gearbox



## Example 1 : reading encoder using QEI in Timer 3

TIM3 Mode and Configuration

**Mode**

Slave Mode

Trigger Source

Clock Source

Channel1

Channel2

Channel3

Channel4

Combined Channels

☐ Use ETR as Clock

☐ XOR activation

☐ One Pulse Mode

☐ PWM Input on CH1

☐ PWM Input on CH2

☐ XOR ON / Hall Sensor Mode

TIM3 Mode and Configuration

**Mode**

Slave Mode

Trigger Source

Clock Source

**Configuration**

Reset Configuration

☒ DMA Settings ☒ GPIO Settings

☒ Parameter Settings ☒ User Constants ☒ NVIC Settings

Configure the below parameters :

Search (Ctrl+F)

Counter Settings

Prescaler (PSC - 16 bit... 0

Counter Mode

Counter Period (AutoR... 3071

Internal Clock Division (No Division

auto-reload preload

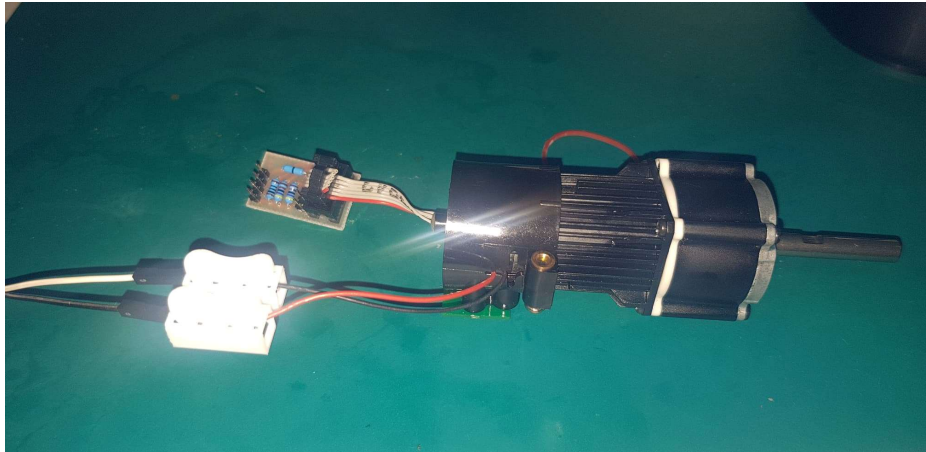
Trigger Output (TRGO) Param...

Master/Slave Mode (M...

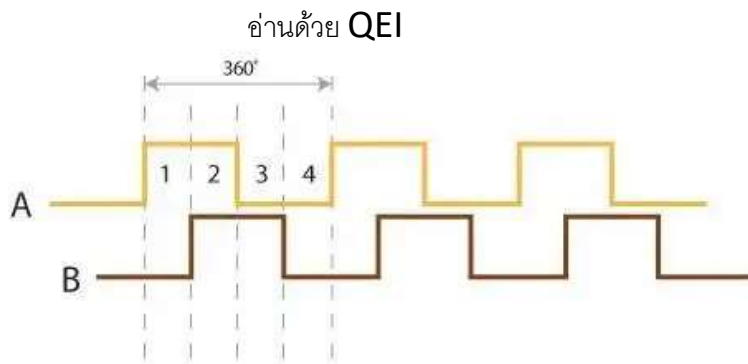
Trigger Event Selection

Encoder Mode

Polarity



$$12 \text{ โป๊ต} \times \text{อัตราทด } 64 : 1 = 768 \text{ P/R}$$



$$768 \text{ P/R} \times 4 = 3072 \text{ P/R}$$

```
/* USER CODE BEGIN PV */
```

```
uint32_t QEIRaw;
```

```
/* USER CODE END PV */
```

```
/* USER CODE BEGIN 2 */
```

```
HAL_TIM_Encoder_Start(&htim3, TIM_CHANNEL_1|TIM_CHANNEL_2);
```

```
/* USER CODE END 2 */
```

```
/* USER CODE BEGIN 3 */
```

```
QEIRaw = __HAL_TIM_GET_COUNTER(&htim3);
```

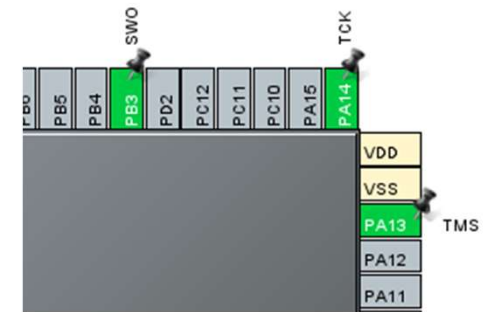
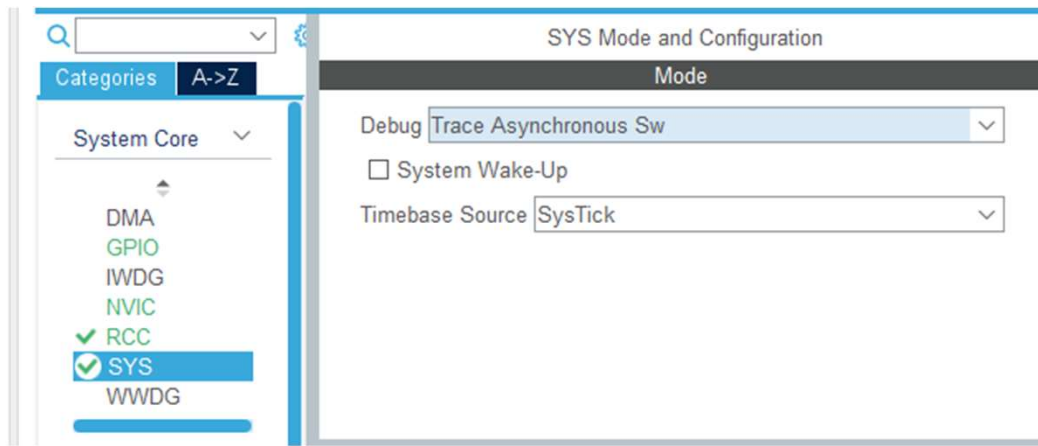
```
}
```

```
/* USER CODE END 3 */
```

## Exercise : Calculate Angle



## Debugger 1 : printf()



```

279⊖ /* USER CODE BEGIN 4 */
280 /*re-implement _write function of printf*/
281⊖ int _write(int file,char *ptr,int len)
282 {
283     int i;
284
285     for(i = 0;i<len; i++)
286     {
287         ITM_SendChar(*ptr++);
288     }
289     return len;
290 }
291 /* USER CODE END 4 */

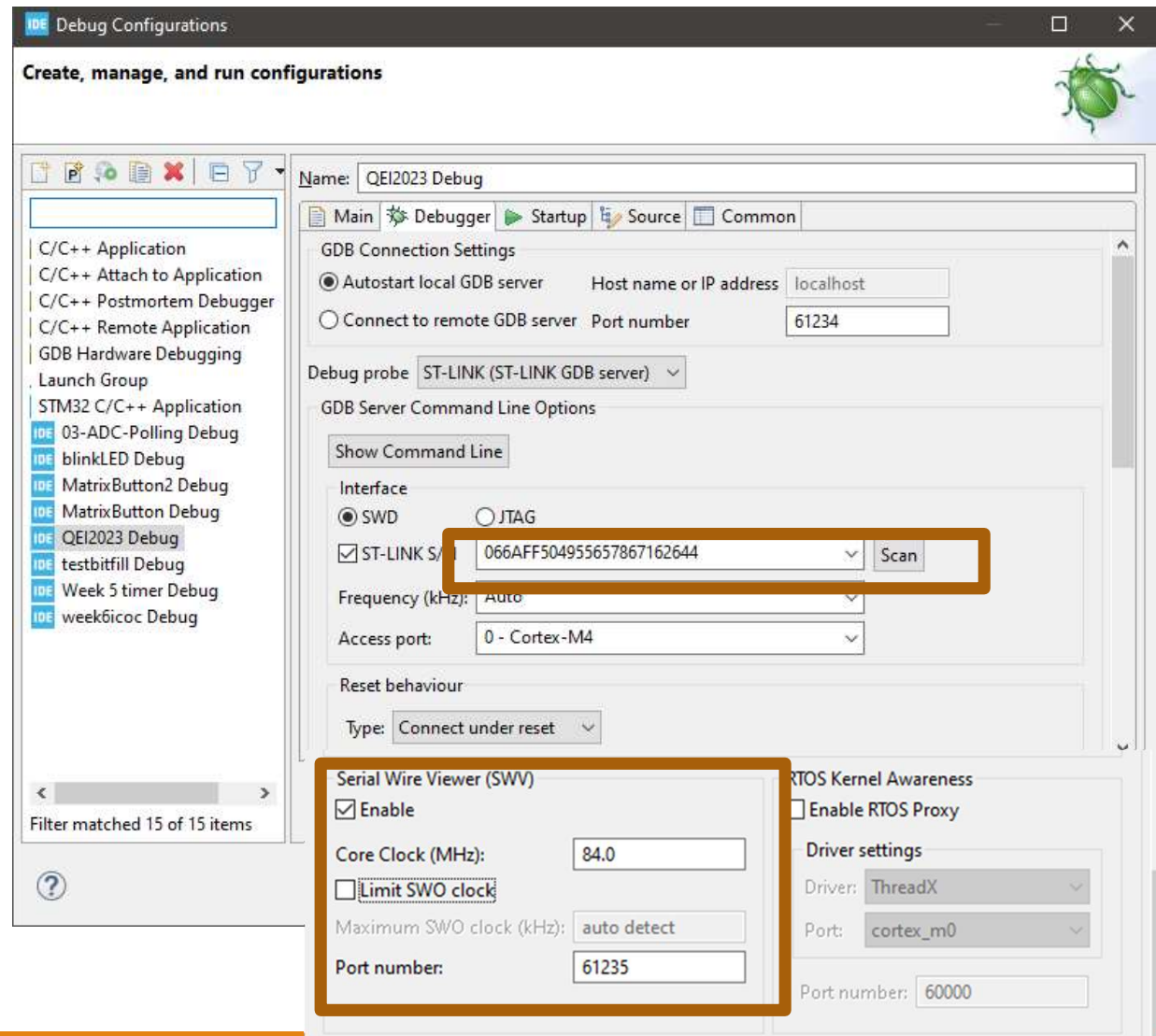
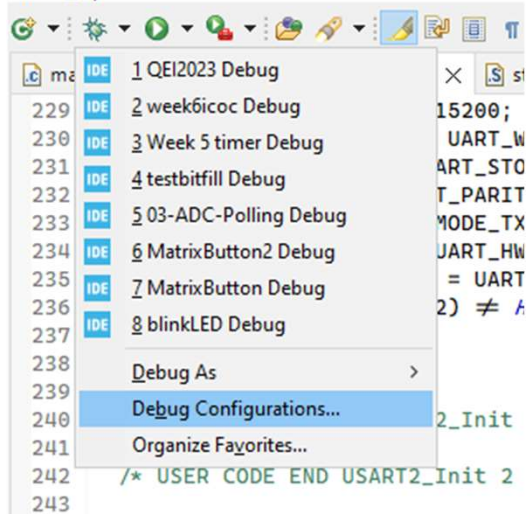
```

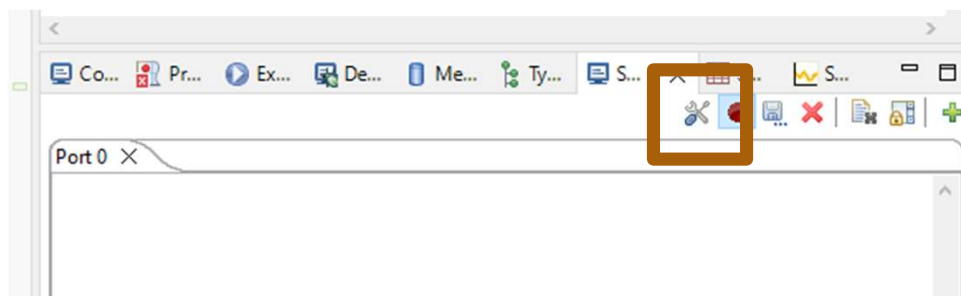
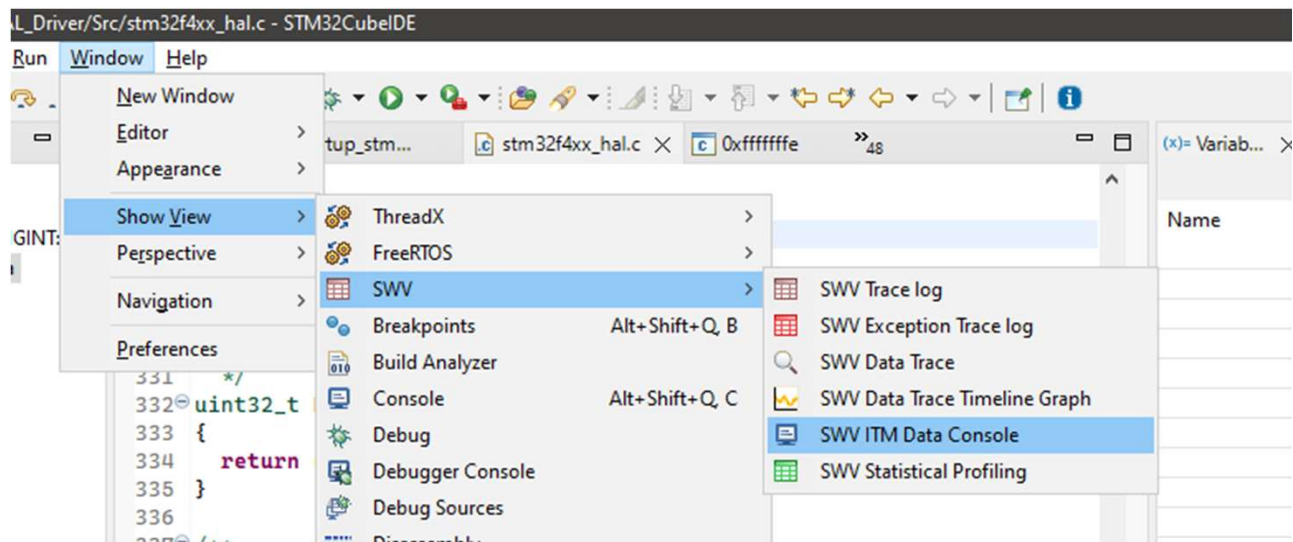
```

/* USER CODE BEGIN 3 */
static uint32_t timestamp =0;
if(HAL_GetTick()>timestamp)
{
    timestamp = HAL_GetTick() + 500;
    QEIRawRead = __HAL_TIM_GET_COUNTER(&htim3);
    printf("Position = %ld\n",QEIRawRead);
}
/* USER CODE END 3 */

```

low Help





Serial Wire Viewer settings forQEI2023 Debug

Clock Settings

Core Clock: 84 MHz

Clock Prescaler: 42

SWO Clock: 2000.0 kHz

Trace Events

☐ CPI: Cycles per instruction

☐ EXC: Exception overhead

☐ SLEEP: Sleep cycles

☐ LSU: Load store unit cycles

☐ FOLD: Folded instructions

☐ EXETRC: Trace Exceptions

PC Sampling

☐ Enable Resolution: 16384 Cycles/sample

Timestamps

☒ Enable Prescaler: 1

Data Trace

Comparator 0

☐ Enable

Var/Addr: 0x0

Access: Read/Write

Size: Word

Generate: Data Value

Comparator 1

☐ Enable

Var/Addr: 0x0

Access: Read/Write

Size: Word

Generate: Data Value

Comparator 2

☐ Enable

Var/Addr: 0x0

Access: Read/Write

Size: Word

Generate: Data Value

Comparator 3

☐ Enable

Var/Addr: 0x0

Access: Read/Write

Size: Word

Generate: Data Value

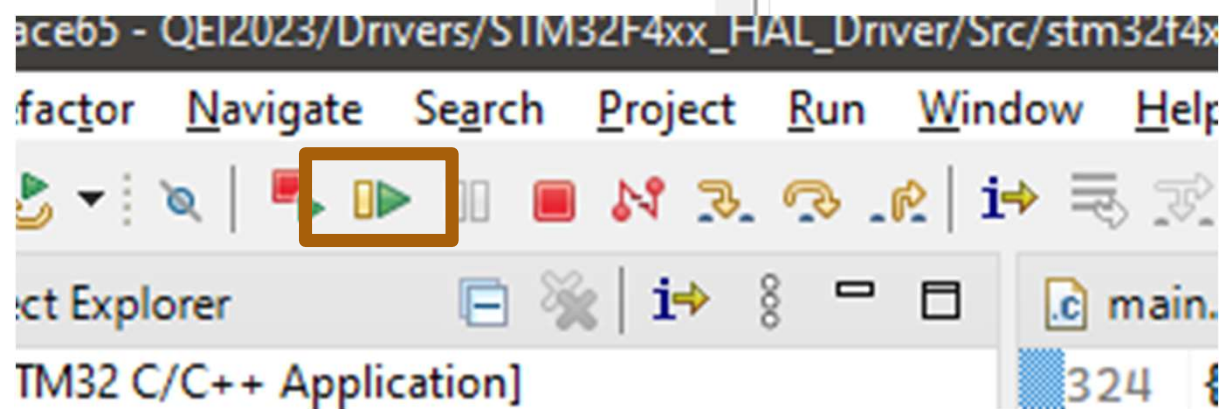
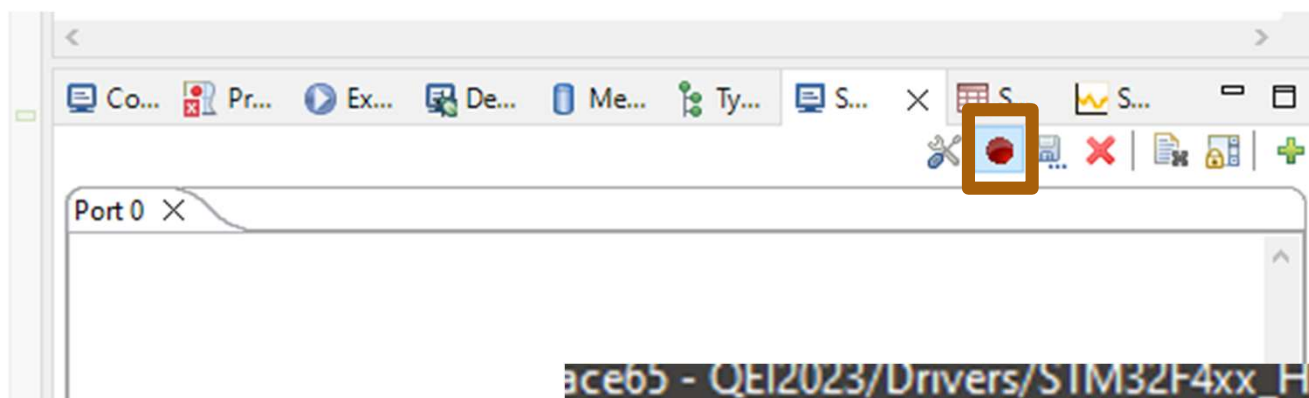
ITM Stimulus Ports

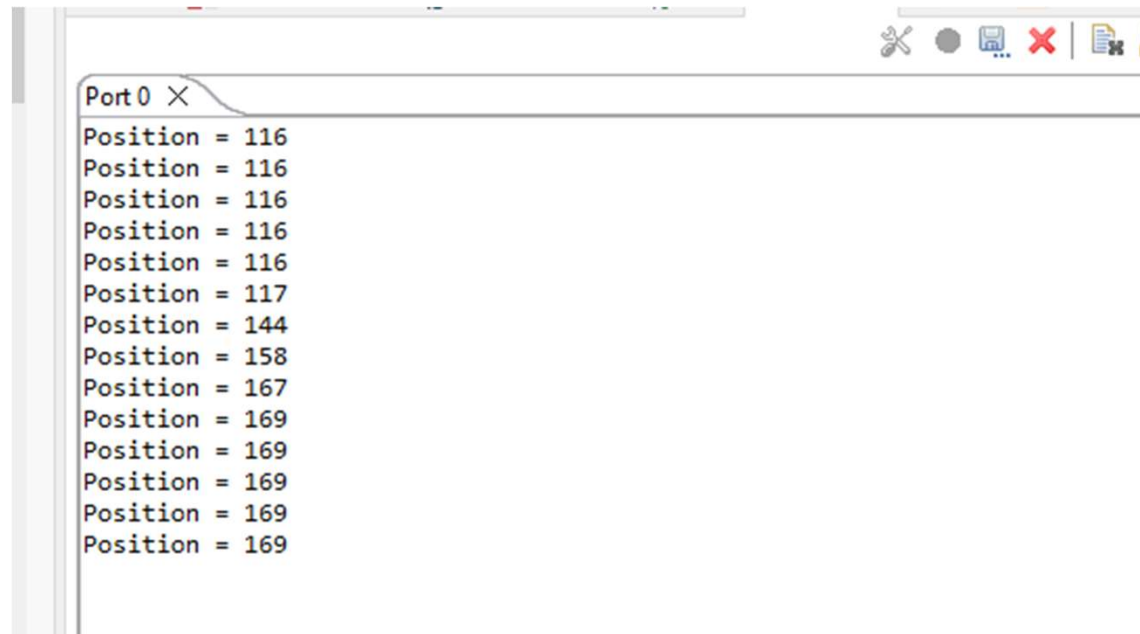
Enable port: 31 24 23 16 15 8 7 0

Privileged only ports: ☐ Port 31..24 ☐ Port 23..16 ☐ Port 15..8 ☐ Port 7..0

OK

Cancel





## Example 2 : calculate angular velocity with QEI

**TIM3 Mode and Configuration**

**Mode**

Slave Mode

Trigger Source

Clock Source

Channel1

Channel2

Channel3

Channel4

Combined Channels

**Configuration**

☒ DMA Settings ☒ GPIO Settings

☒ Parameter Settings ☒ User Constants ☒ NVIC Settings

Configure the below parameters :

Counter Settings

Prescaler (PSC - 16 bit... 0)

Counter Mode

Counter Period (AutoR... QEI\_PERIOD -1)

Internal Clock Division (... No Division)

auto reload preload

**Configuration**

☒ DMA Settings ☒ GPIO Settings

☒ Parameter Settings ☒ User Constants ☒ NVIC Settings

Search Constants

Constant Name	Constant Value
QEI_PERIOD	64512



## Create microsecond timer

Pinout & Configuration | Clock Configuration | Project

Software Packs | Pinout

Search

Categories | A-Z

- DMA
- GPIO
- IWDG
- NVIC
- ✓ RCC
- ✓ SYS
- WWDG

Analog >

Timers ▾

- RTC
- TIM1
- ⚠ TIM2
- ✓ TIM3
- TIM4
- ⚠ TIM5
- ⚠ TIM9
- TIM10
- TIM11

TIM5 Mode and Configuration

Mode

Slave Mode: Disable

Trigger Source: Disable

☒ Internal Clock

Channel1: Disable

Channel2: Disable

Channel3: Disable

Channel4: Disable

Combined Channels: Disable

Configuration

Reset Configuration

✓ NVIC Settings | ✓ DMA Settings

✓ Parameter Settings | ✓ User Constants

Configure the below parameters :

Search (Ctrl+F) < > i

Counter Settings

- Prescaler (PSC - 16 bit... 83
- Counter Mode Up
- Counter Period (AutoR... 4294967295
- Internal Clock Division (... No Division
- auto-reload preload Disable

Configuration			
Reset Configuration			
✓ NVIC Settings	✓ DMA Settings		
✓ Parameter Settings	✓ User Constants		
NVIC Interrupt Table	Enabled	Preemption Priority	Sub Priority
TIM5 global interrupt	<input checked="" type="checkbox"/>	0	0

```

/* USER CODE BEGIN PV */
typedef struct _QEIStructure
{
    uint32_t data[2];    //Position data content
    uint64_t timestamp[2];

    float QEIPosition; //step
    float QEIVelocity; //step/sec
}QEIStructureTypeDef;
QEIStructureTypeDef QEIData = {0};

uint64_t _micros = 0;
/* USER CODE END PV */

```

```

E BEGIN 4 */

```

```

1 /* USER CODE BEGIN PFP */
2 inline uint64_t micros();
3 void QEIEncoderPositionVelocity_Update();
4 /* USER CODE END PFP */

```

```

//microsec timer implement
void HAL_TIM_PeriodElapsedCallback(TIM_HandleTypeDef *htim)
{
    if(htim == &htim5)
    {
        _micros += UINT32_MAX;
    }
}

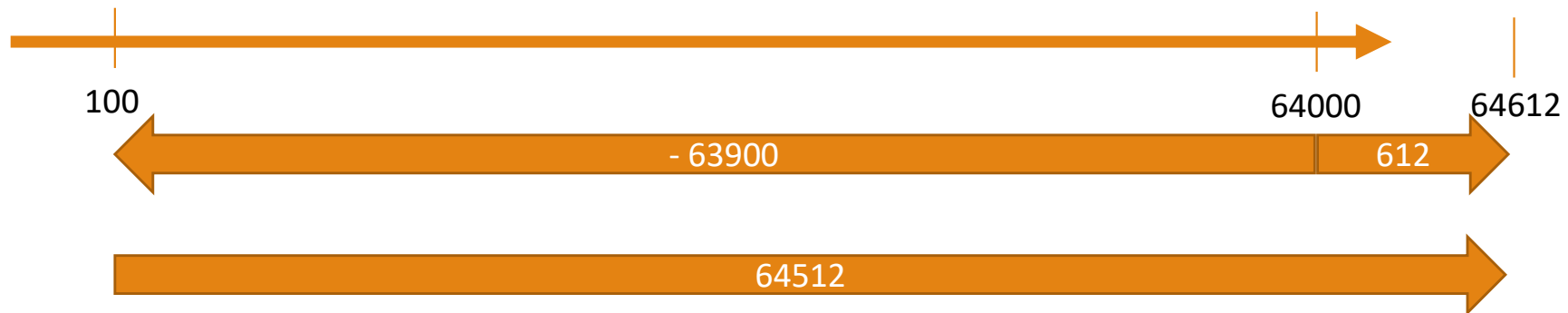
uint64_t micros()
{
    return __HAL_TIM_GET_COUNTER(&htim5)+_micros;
}

```

```

1  /* USER CODE BEGIN 4 */
2  void QEIEncoderPositionVelocity_Update()
3  {
4      //collect data
5      QEIData.timestamp[0] = micros();
6      uint32_t couterPosition = __HAL_TIM_GET_COUNTER(&htim3);
7      QEIData.data[0] = couterPosition ;
8
9
10     //calculation
11     QEIData.QEIPosition = couterPosition % 3072;
12
13
14     int32_t diffPosition = QEIData.data[0] - QEIData.data[1];
15     float difftime = (QEIData.timestamp[0]-QEIData.timestamp[1]);
16
17     //handle wrap-around
18     if(diffPosition > QEI_PERIOD>>1) diffPosition -= QEI_PERIOD;
19     if(diffPosition < -(QEI_PERIOD>>1)) diffPosition += QEI_PERIOD;
20
21     //calculate angular velocity in pulse per sec
22     QEIData.QEIVelocity = (diffPosition * 1000000)/difftime;
23
24
25     QEIData.data[1] = QEIData.data[0];
26     QEIData.timestamp[1] = QEIData.timestamp[0];
27
28 }

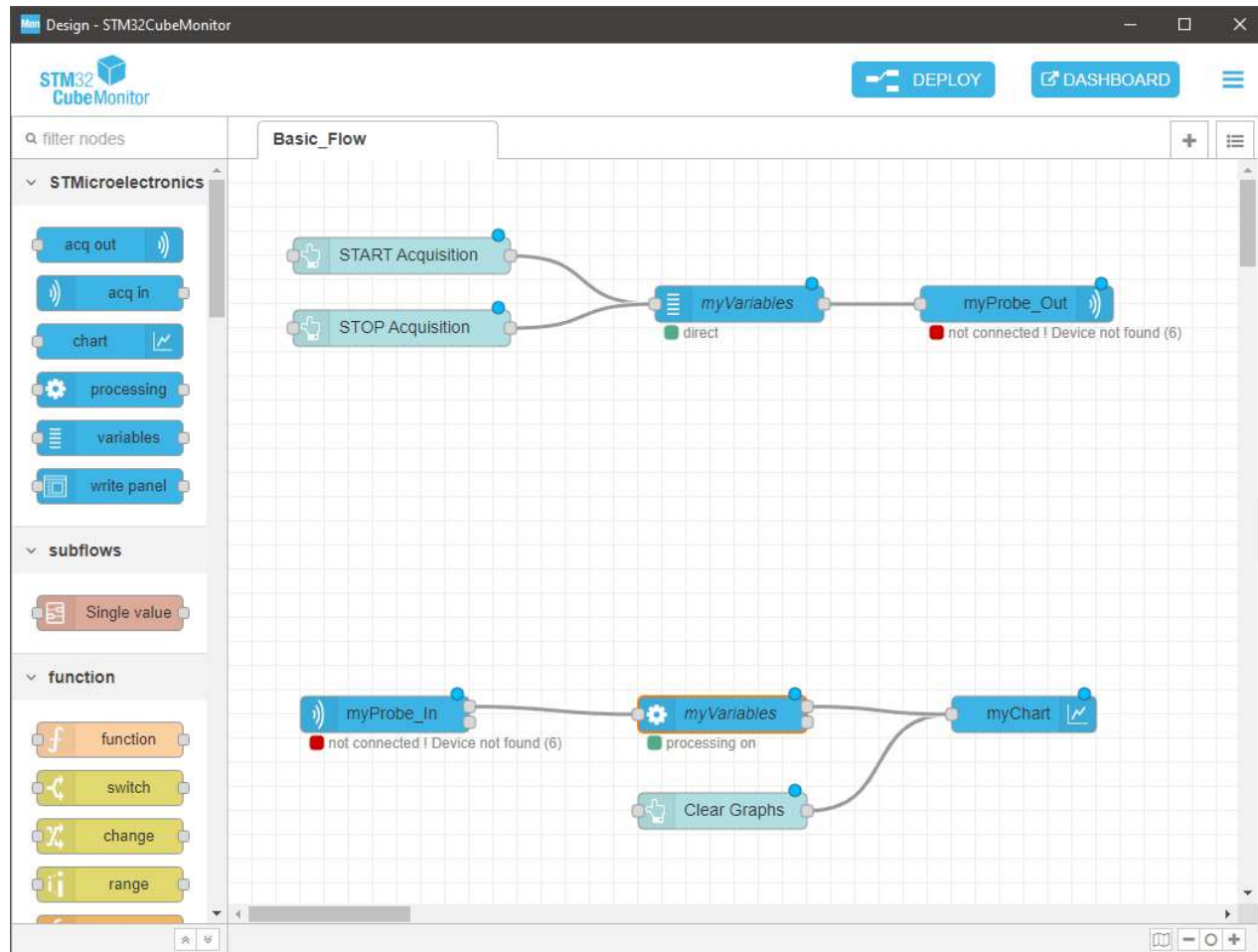
```



```
/* USER CODE BEGIN WHILE */
while (1)
{
    /* USER CODE END WHILE */

    /* USER CODE BEGIN 3 */
    static uint64_t timestamp =0;
    int64_t currentTime = micros();
    if(currentTime>timestamp) // 10 Hz
    {
        timestamp = currentTime + 100000;
        QEIEncoderPositionVelocity_Update(currentTime);
    }
}
/* USER CODE END 3 */
```

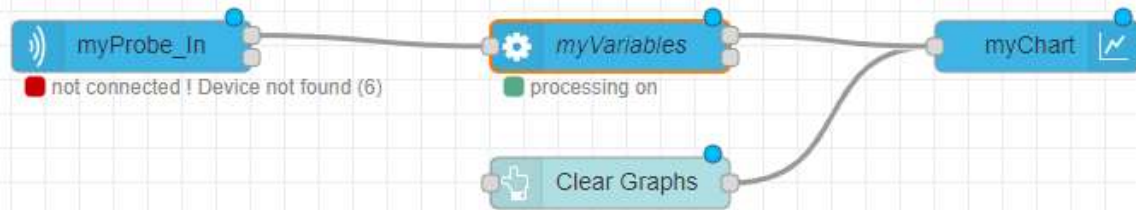
## STM32CubeMonitor

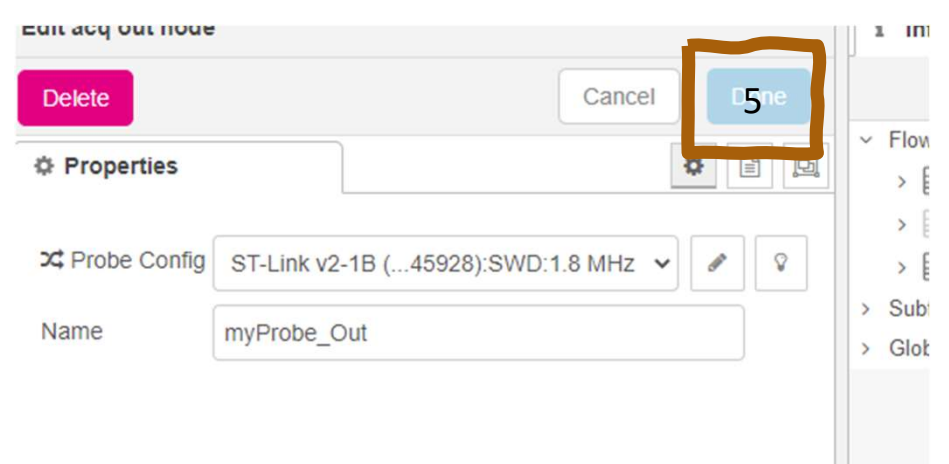
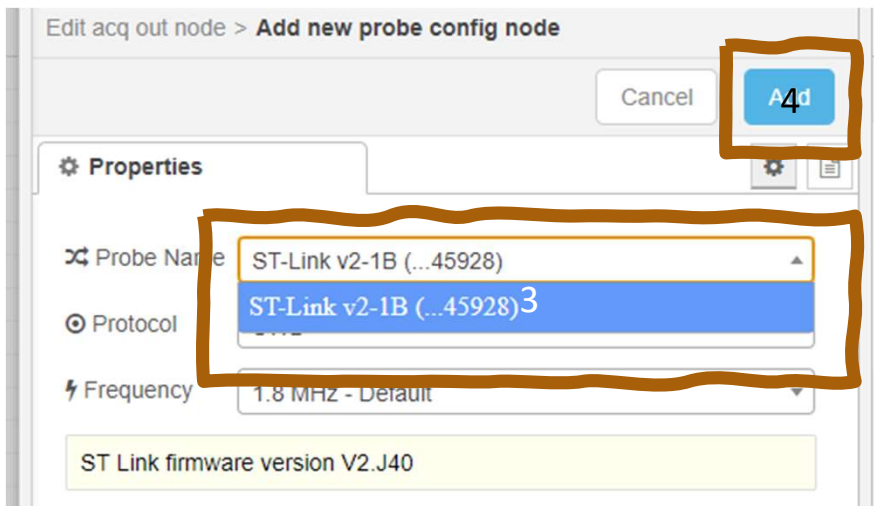
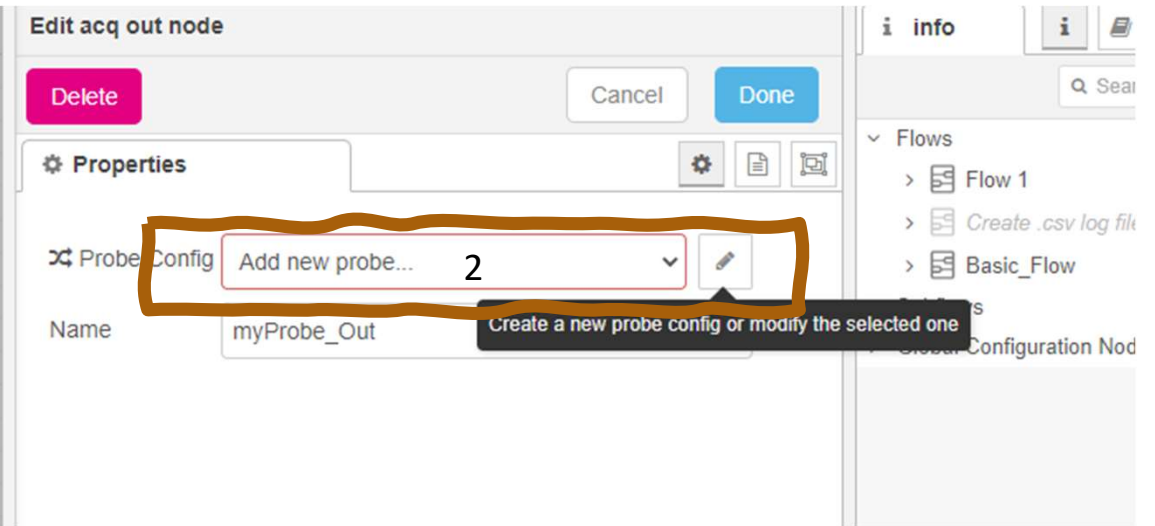
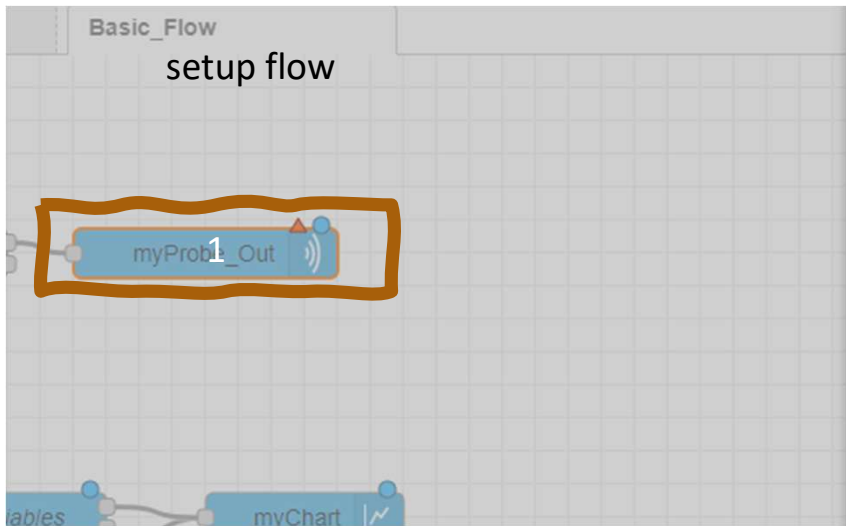




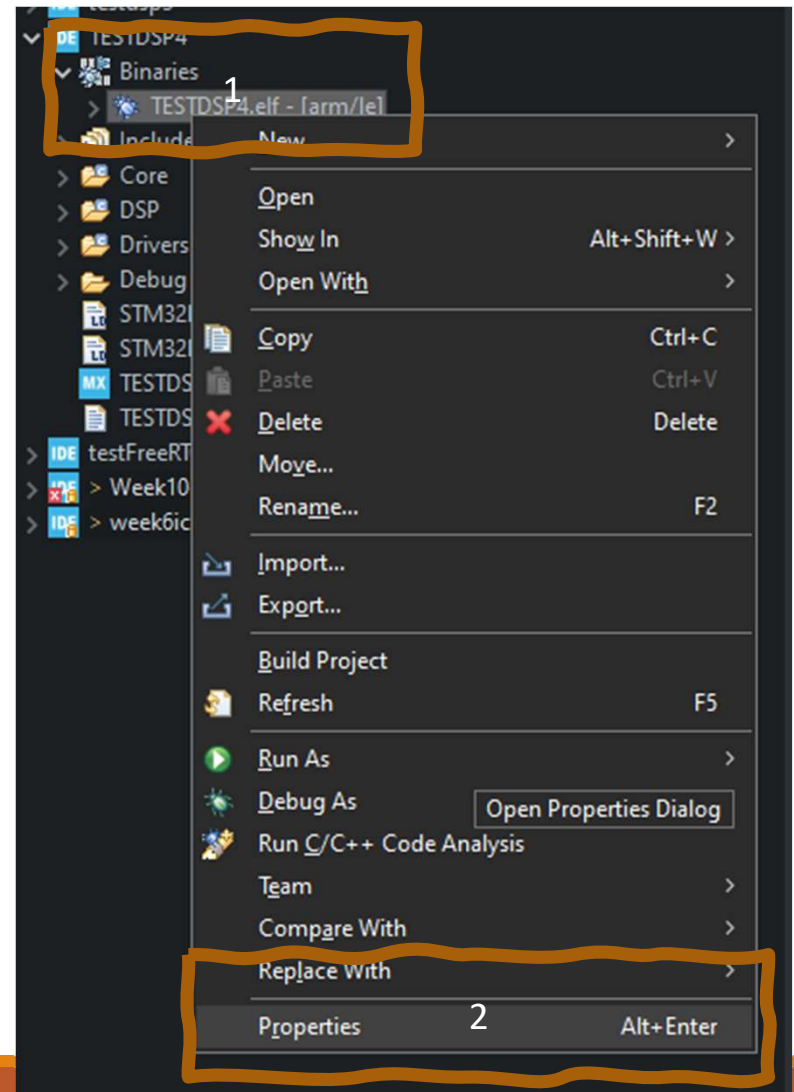
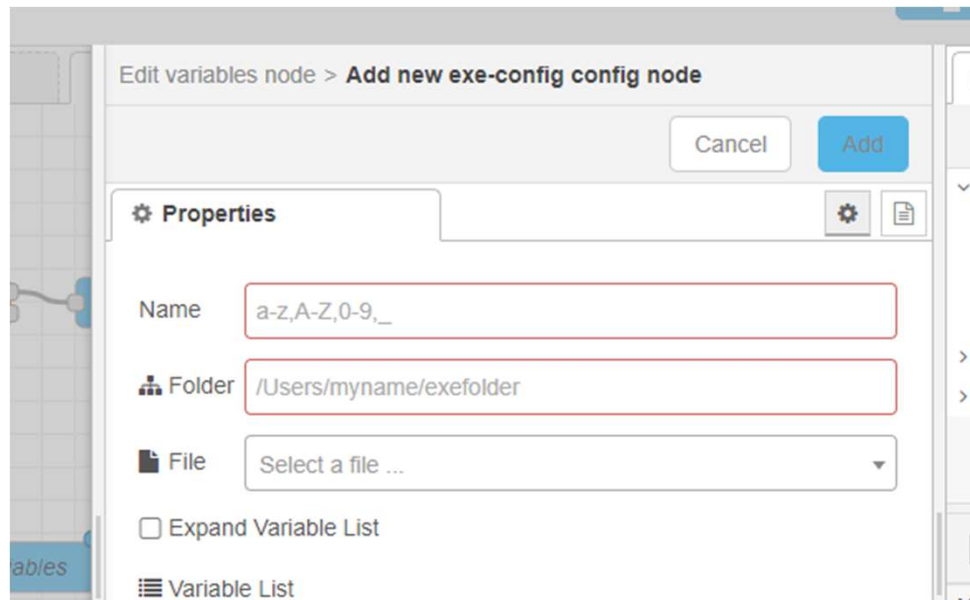
To F411RE

From F411RE









Filter text

Resource

C/C++ Build

Paths and Symbols

Preprocessor Include Paths,

Run/Debug Settings

Resource

Path: /TESTDSP4/Debug/TESTDSP4.elf

Type: File (Executable File)

Location: F:\Mi2021\TESTDSP4\Debug\TESTDSP4.elf

Size: 852,040 bytes

Last modified: March 15, 2023, 12:41:48 AM

เลือกตัวแปรที่อยากดู

Edit variables node > Add new exe-config config node

Cancel Add

Properties

Name group1

Folder F:\Mi2021\TESTDSP4\Debug\

File TESTDSP4.elf

☒ Expand Variable List

Variable List

Select Name	Start Address	Type
<input type="checkbox"/> huart2.RxState	0x20000066	Signed 8-bit
<input type="checkbox"/> huart2.RxXferCount	0x20000056	Unsigned 16-bit
<input type="checkbox"/> huart2.RxXferSize	0x20000054	Unsigned 16-bit
<input type="checkbox"/> huart2.TxXferCount	0x2000004e	Unsigned 16-bit
<input type="checkbox"/> huart2.TxXferSize	0x2000004c	Unsigned 16-bit
<input type="checkbox"/> SystemCoreClock	0x20000000	Unsigned 32-bit
<input checked="" type="checkbox"/> uwTick	0x2000006c	Unsigned 32-bit
<input type="checkbox"/> uwTickReq	0x20000008	Signed 8-bit
<input type="checkbox"/> uwTickPrio	0x20000004	Unsigned 32-bit

☒ Select All ☐ Deselect All

Filter on variable name

☐ Enabled 0 nodes use this config On all flows

**Edit variables node**

**Delete** **Cancel** **Done**

**Properties**

Group Name: myVariables

Access point: 0

Executable: group1 (TESTDSP4.elf)

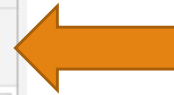
**Variable list**

Name	Start Address	Type
uwTick	0x2000006c	Unsigned 32-bit

+ Add custom variable - Remove all custom variables

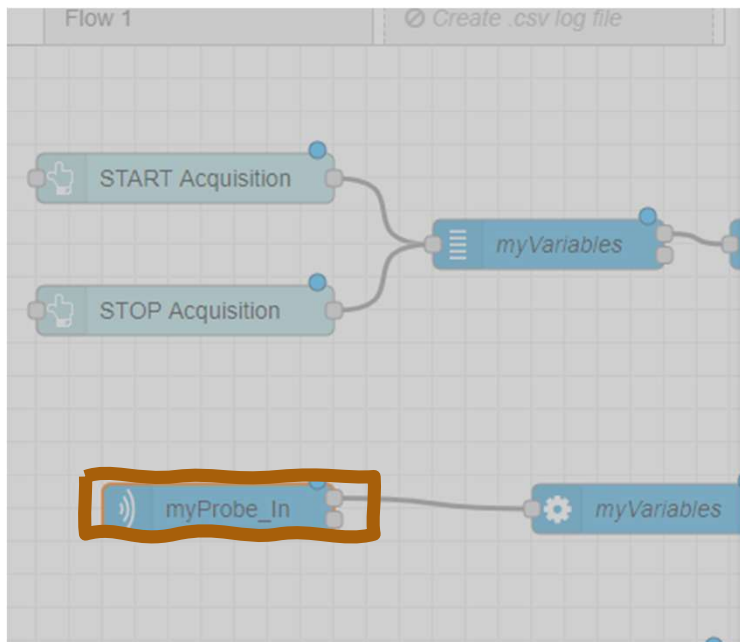
**Acquisition parameters**

sequential loop



ปรับความถี่ในการอ่าน (ค่าประมาณ)





### Edit acq in node

Delete Cancel **Done**

#### Properties

Probe onfig ST-Link v2-1B (...92531):SWD:1.8 MHz

Name myProbe\_In

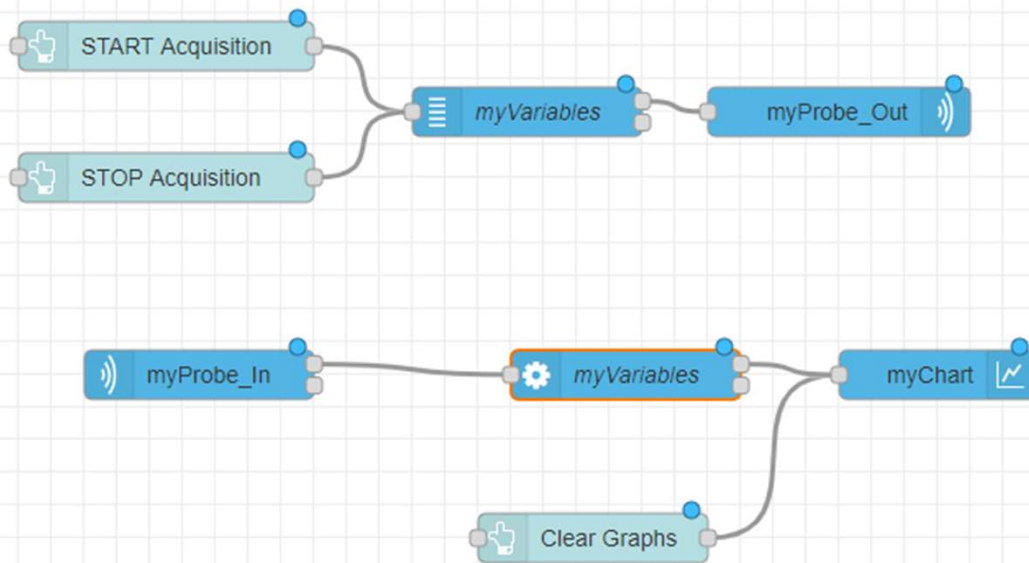
DEPLOY

DASHBOARD

Flow 1

Create .csv log file

Basic\_Flow



info

i

📄

🔍

⚙️

📊

⌵

Search flows

Flows

> Flow 1

> Create .csv log file

> Basic\_Flow

> Subflows

> Global Configuration Nodes

myVariables

Node "43a30ca7.f4c224"

Type processing

show more

ctrl-space will toggle the view of this sidebar

