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DesignNews

Scratch Building Raspberry Pi RP2040 IoT Devices

Day 5:

Coding a Raspberry Pi Pico W ToF Application

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- Turn on your system sound to hear the streaming presentation.
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Fred Eady

Visit ‘Lecturer Profile’ in your console for more details.

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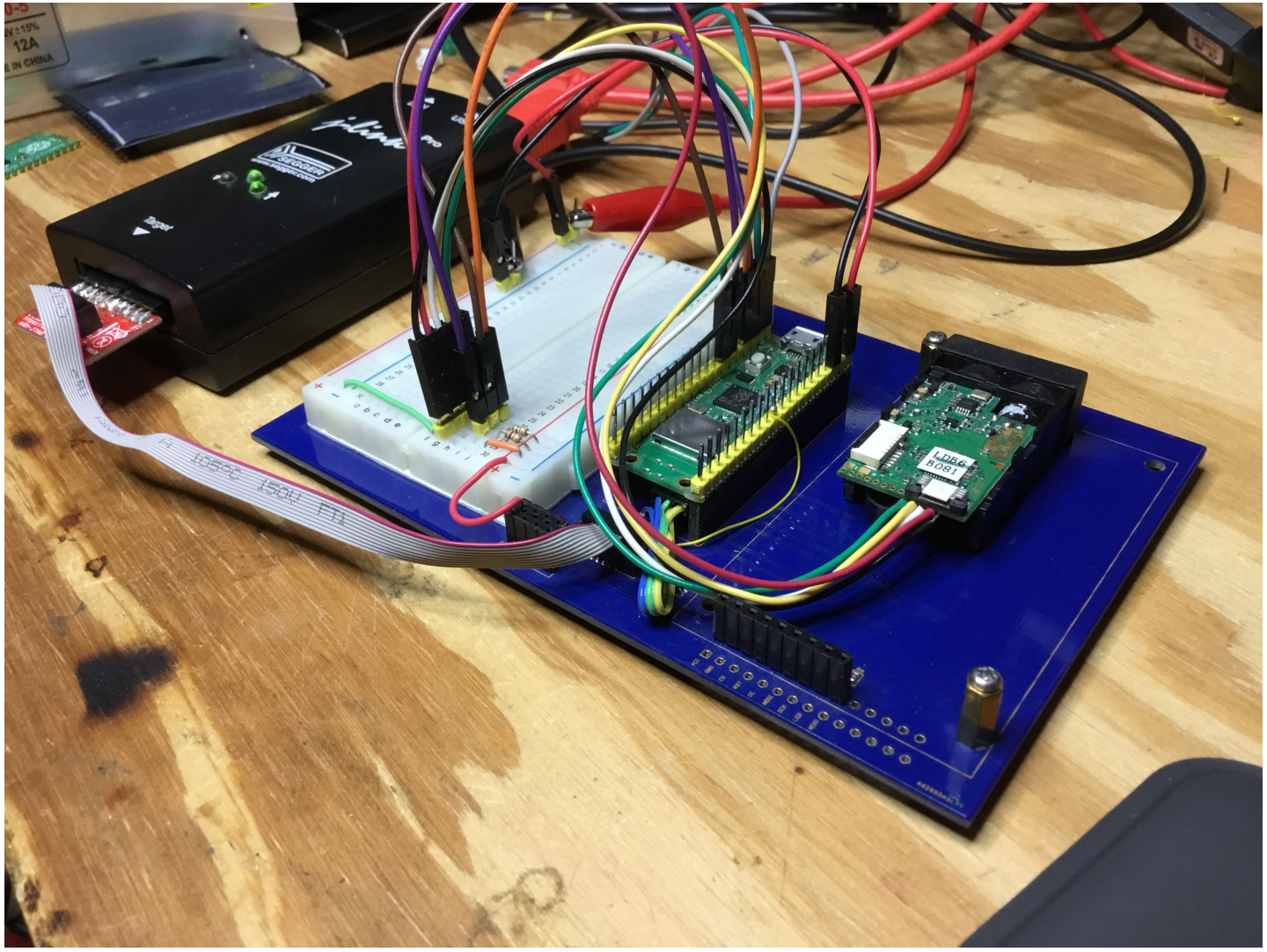
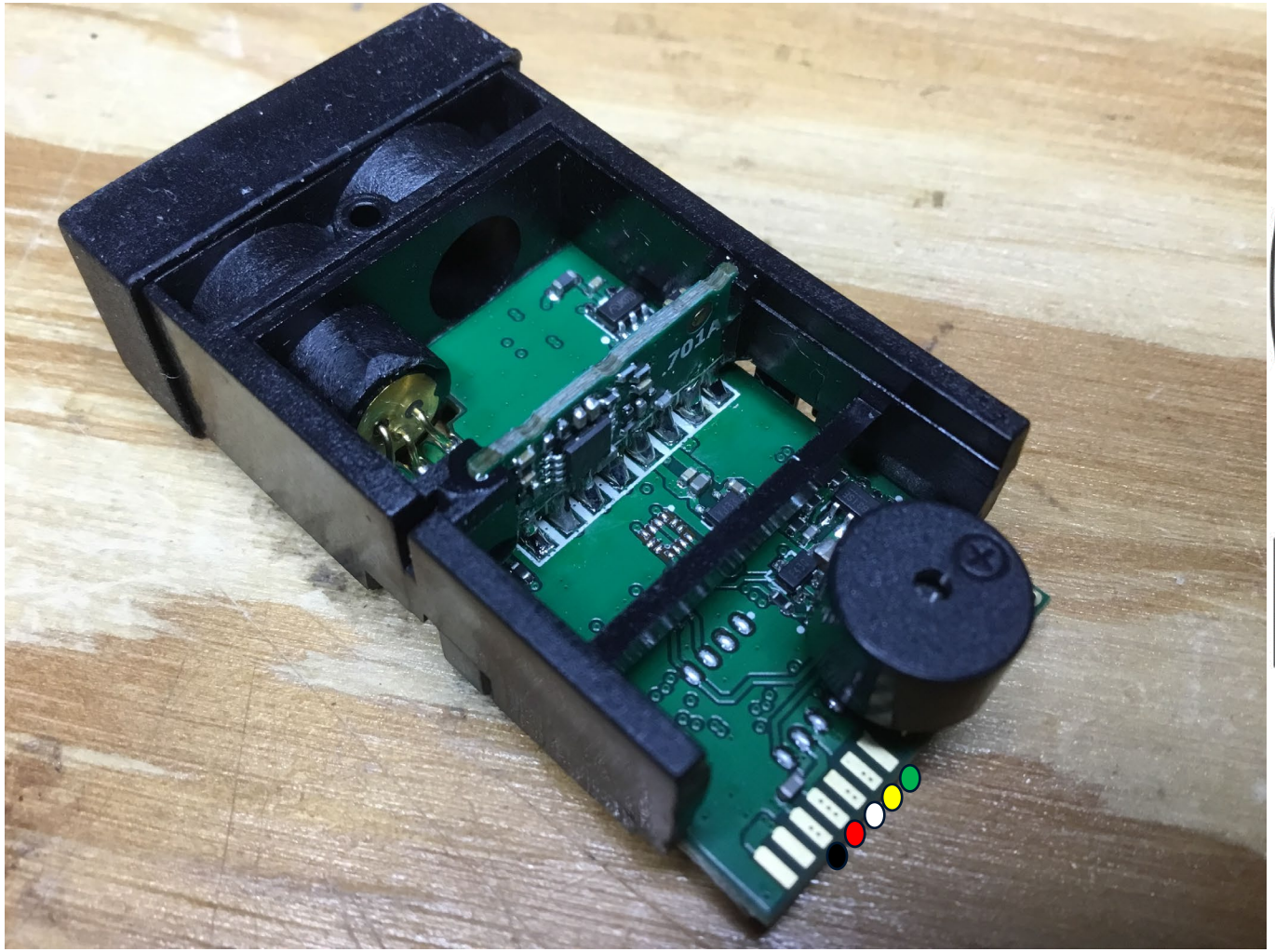
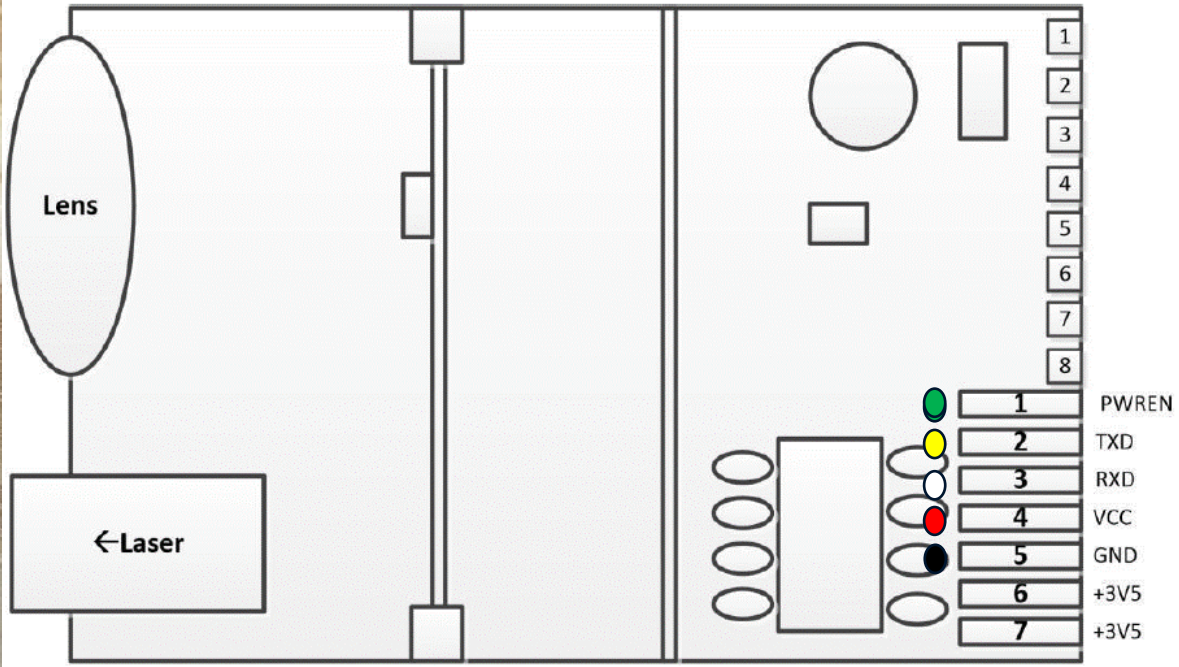
AGENDA

- **Hardware Hookup**
- **The Merge**

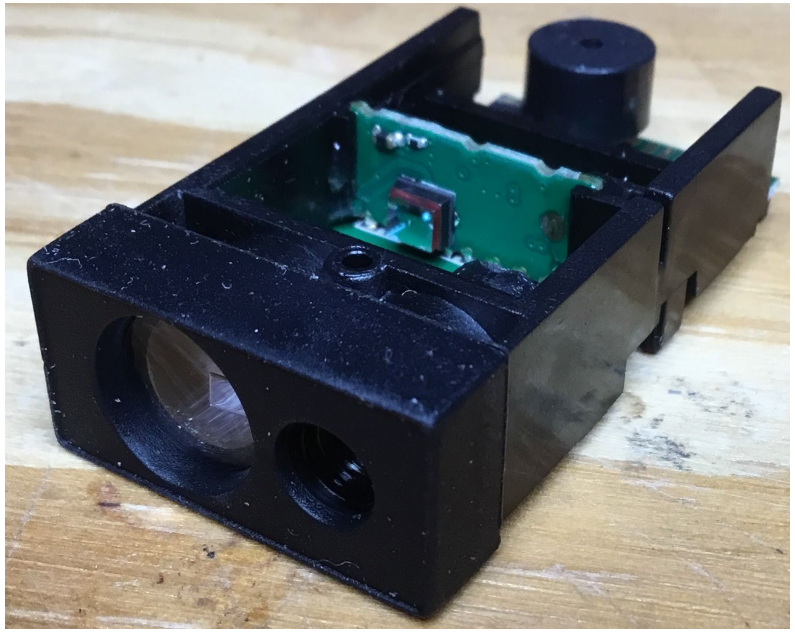


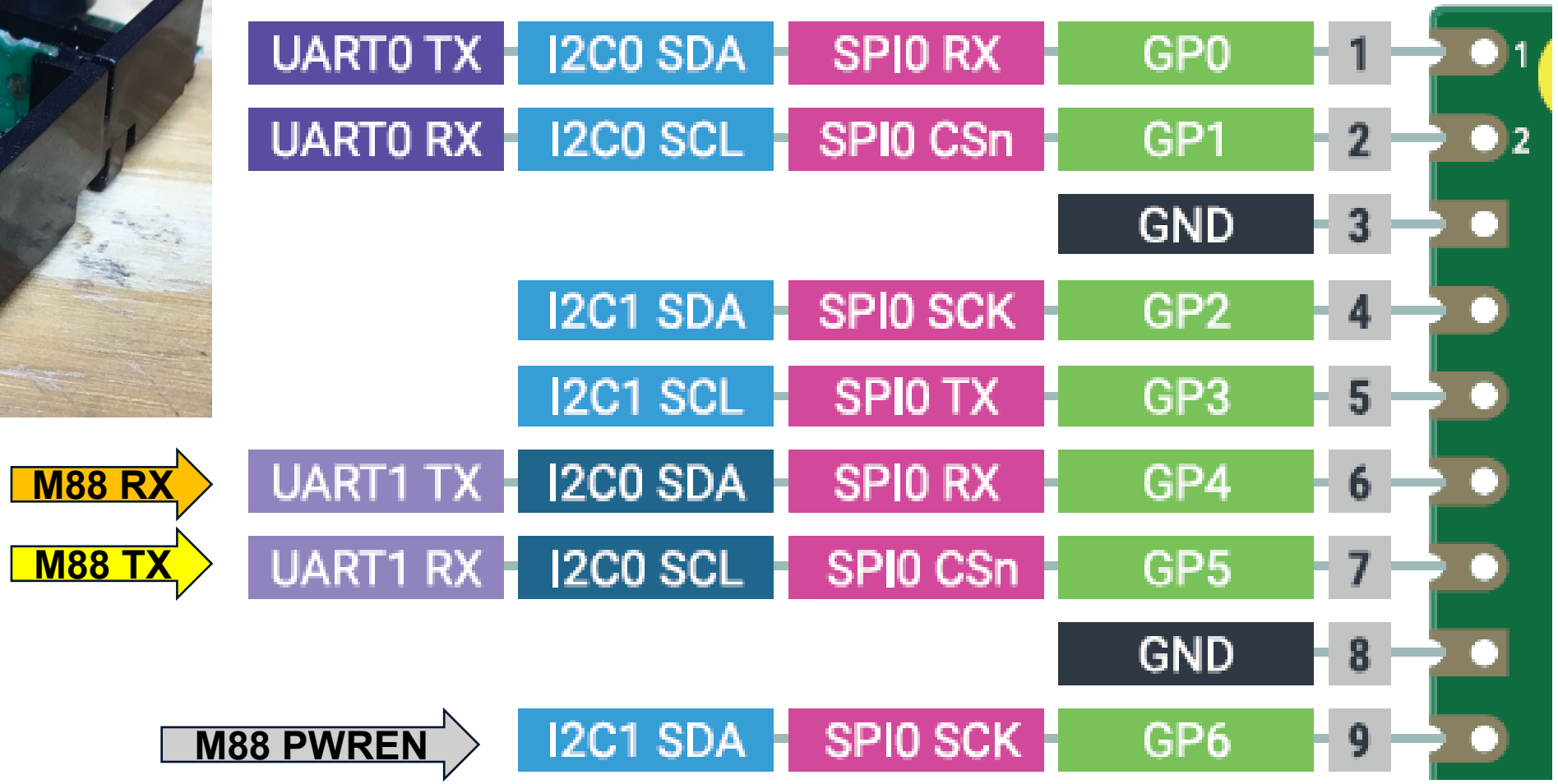
M88 ToF Module Hookup



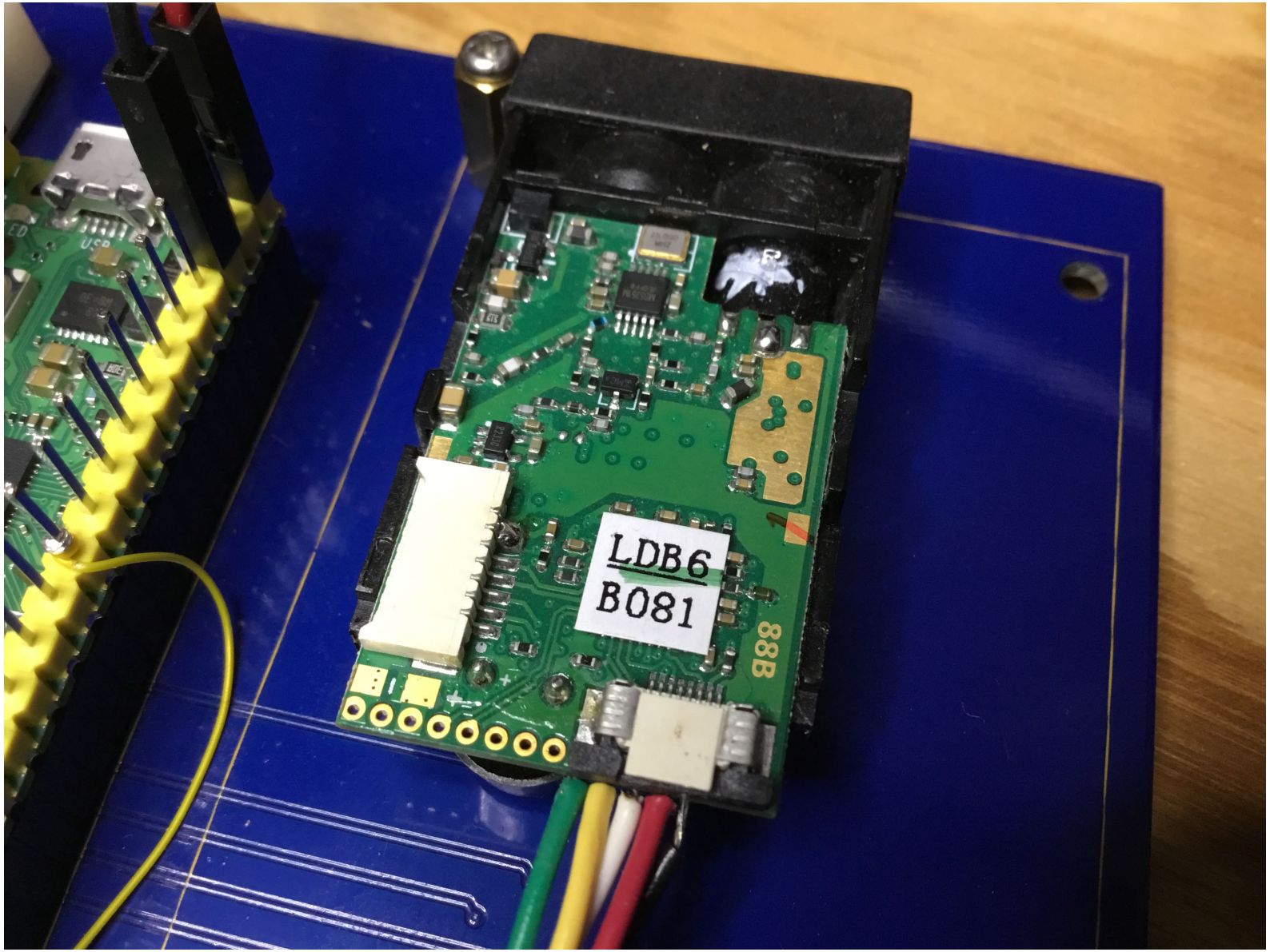


M88 ToF Module Hookup

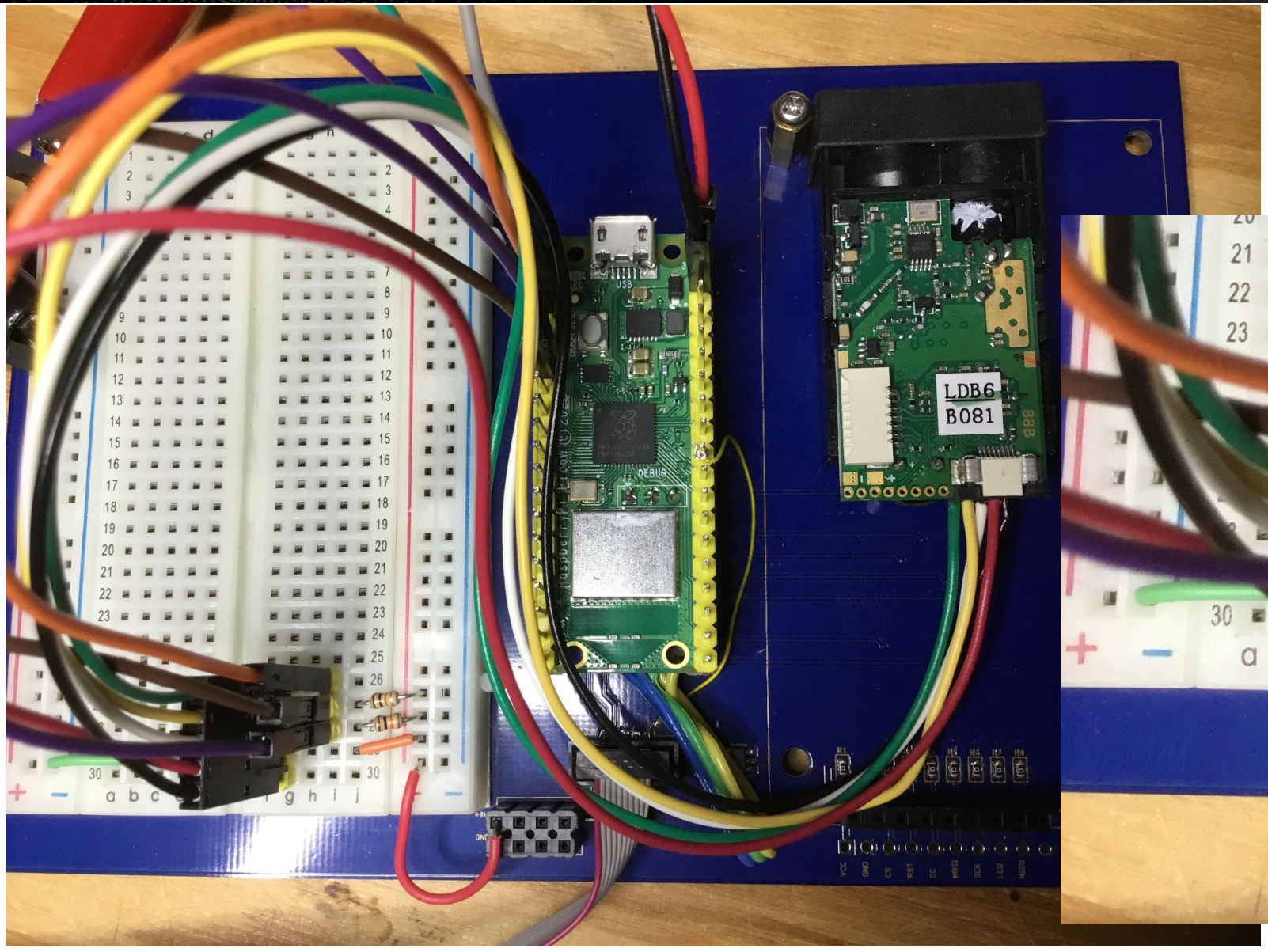


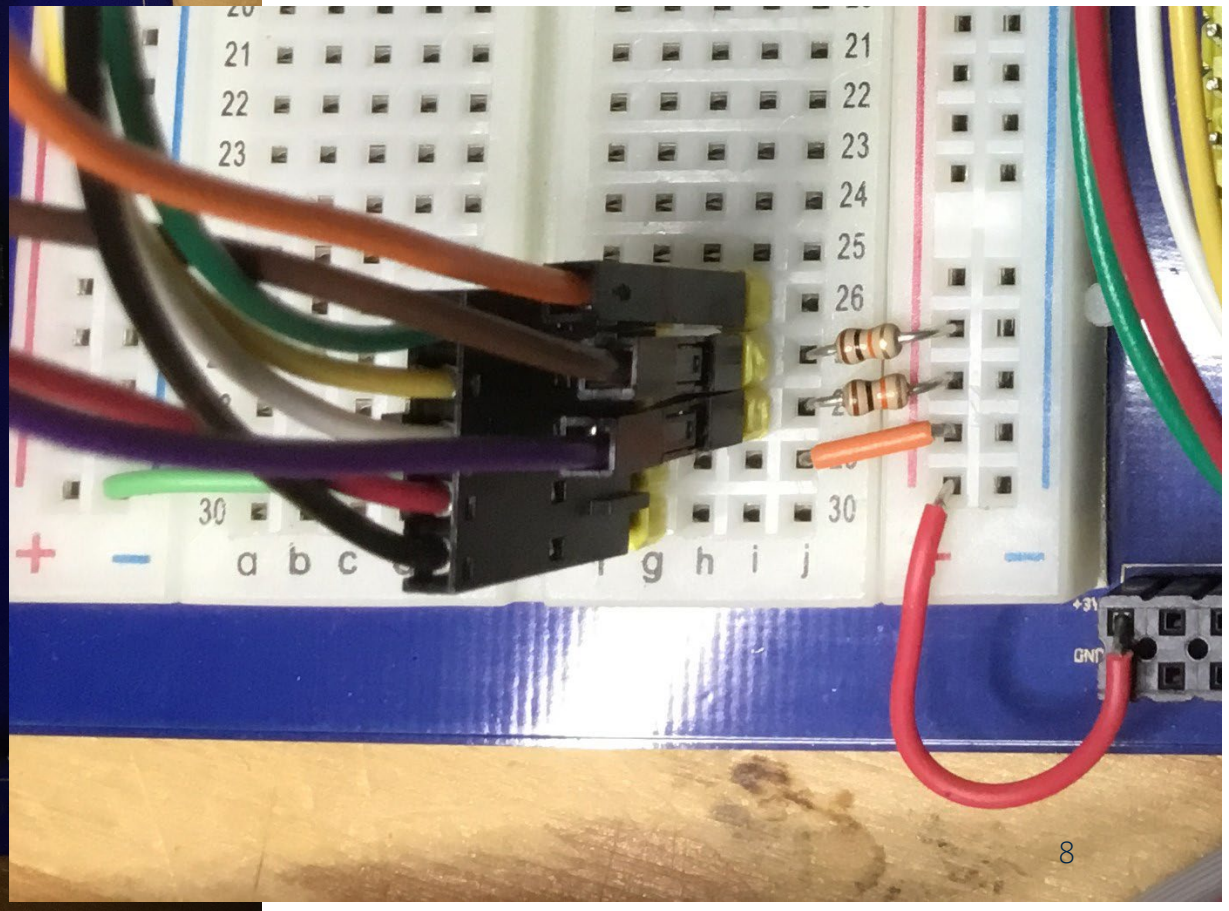


M88 ToF Module Hookup



M88 ToF Module Hookup





CMakeLists.txt – Add Executables

M CMakeLists.txt

```
1  # Set minimum required version of CMake
2  cmake_minimum_required(VERSION 3.12)
3
4  # Include build functions from Pico SDK
5  include($ENV{PICO_SDK_PATH}/external/pico_sdk_import.cmake)
6
7  # Set name of project (as PROJECT_NAME) and C/C++ standards
8  project(tofClient C CXX ASM)
9  set(CMAKE_C_STANDARD 11)
10 set(CMAKE_CXX_STANDARD 17)
11
12 # Creates a pico-sdk subdirectory in our project for the libraries
13 pico_sdk_init()
14
15 if (NOT TEST_TCP_SERVER_IP)
16     message("Skipping tcp_client example as TEST_TCP_SERVER_IP is not defined")
17 else()
18     add_executable(${PROJECT_NAME}
19         tofClient.c
20         tof.c
21         M8driver.c
22
23         )
24     target_compile_definitions(${PROJECT_NAME} PRIVATE
25         WIFI_SSID=\"${WIFI_SSID}\"
26         WIFI_PASSWORD=\"${WIFI_PASSWORD}\"
27         TEST_TCP_SERVER_IP=\"${TEST_TCP_SERVER_IP}\"
28         )
29     target_include_directories(${PROJECT_NAME} PRIVATE
30         ${CMAKE_CURRENT_LIST_DIR}
31         ${CMAKE_CURRENT_LIST_DIR}/.. # for our common lwipopts
32         )
33     target_link_libraries(${PROJECT_NAME}
34         pico_cyw43_arch_lwip_poll
35         pico_stdlib
36         )
37     pico_add_extra_outputs(${PROJECT_NAME})
38 endif()
```

tofClient.c – Add Modified Init UARTs Function

C tofClient.c

```
182
183
184 //*****************************************************************************
185 //* MAIN FUNCTION
186 //*****************************************************************************
187 int main()
188 {
189     stdio_init_all();
190     init_uarts();
191     if (cyw43_arch_init())
192     {
193         DEBUG_printf("failed to initialise\n");
194         return 1;
195     }
196     cyw43_arch_enable_sta_mode();
197
198     printf("Connecting to WiFi...\n");
199     if (cyw43_arch_wifi_connect_timeout_ms(WIFI_SSID, WIFI_PASSWORD, CYW43_AUTH_WPA2_AES_PSK, 30000))
200     {
201         printf("failed to connect.\n");
202         return 1;
203     } else
204     {
205         printf("Connected.\n");
206     }
```

tofClient.c - Use Default Serial Port (Enables printf use)

tof.c > ...

```
86  //*****************************************************************
87  //* INITIALIZE UARTS FUNCTION
88  //*****************************************************************
89  void init_uarts(void)
90  {
91      gpio_init(PWREN_PIN);
92      gpio_set_dir(PWREN_PIN, GPIO_OUT);
93      gpio_put(PWREN_PIN,0);
94
95      //gpio_set_function(UART0_TX_PIN, GPIO_FUNC_UART);
96      //gpio_set_function(UART0_RX_PIN, GPIO_FUNC_UART);
97      gpio_set_function(UART1_TX_PIN, GPIO_FUNC_UART);
98      gpio_set_function(UART1_RX_PIN, GPIO_FUNC_UART);
99
100     //uart_init(UART0_ID, 115200);
101     uart_init(UART1_ID, 115200);
102     //uart_set_hw_flow(UART0_ID, false, false);
103     uart_set_hw_flow(UART1_ID, false, false);
104     //uart_set_format(UART0_ID, DATA_BITS, STOP_BITS, PARITY);
105     uart_set_format(UART1_ID, DATA_BITS, STOP_BITS, PARITY);
106     //uart_set_fifo_enabled(UART0_ID, false);
107     uart_set_fifo_enabled(UART1_ID, false);
```

tofClient.c – Add ToF Init Code to init_uarts

tof.c > ...

```
110
111     irq_set_exclusive_handler(UART1_IRQ, uart1_irq_handler);
112
113     uart_set_irq_enables(UART1_ID, true, false);
114     irq_set_enabled(UART1_IRQ, true);
115
116     memset(rxBuf,0xFF,sizeof(rxBuf));
117     memset(UART1_RxBuf,0x00,sizeof(UART1_RxBuf));
118     UART1_RxHead = 0;
119     UART1_RxTail = 0;
120     busy_wait_ms(100);
121     gpio_put(PWREN_PIN,1);
122     busy_wait_ms(100);
123     setBaud();
124     busy_wait_ms(100);
125     while(!CharInRing());
126     rxBuf[0] = readring();
127     if(rxBuf[0] != 0x00)
128     {
129       printf("\r\nautobaud failed!!!\r\n");
130       while(1);
131     }
132     UART1_RxHead = 0;
133     UART1_RxTail = 0;
134   }
```

tofClient.c – Merge ToF and TCP Client Functionality

C tofClient.c

```
221
222     while(!state->complete)
223     {
224         cyw43_arch_poll();
225         sleep_ms(1);
226         startOneShotSlowMeasure();
227         while(!CharInRing());
228         busy_wait_ms(10);
229         bufIndx = 0;
230         do{
231           rxBuf[bufIndx++] = readring();
232         }while(CharInRing());
233         txBuf[0] = rxBuf[6];
234         txBuf[1] = rxBuf[7];
235         txBuf[2] = rxBuf[8];
236         txBuf[3] = rxBuf[9];
237         err_t err = tcp_write(state->tcp_pcb, txBuf, 0x04, TCP_WRITE_FLAG_COPY);
238
239     }
240     cyw43_arch_deinit();
241     return 0;
242 }
```

M8driver.c – Merge ToF and TCP Client Functionality

```c
C M8driver.c > ...
14
15  uint8_t cmdPkt[9];
16  uint8_t readModuleStatus[5] =          {0xAA,0x80,0x00,0x00,0x80};
17  uint8_t readMeasureResult[5] =         {0xAA,0x80,0x00,0x22,0xA2};
18  uint8_t oneShotAutoDistMeasure[9] =    {0xAA,0x00,0x00,0x20,0x00,0x01,0x00,0x00,0x21};
19  uint8_t oneShotSlowDistMeasure[9] =    {0xAA,0x00,0x00,0x20,0x00,0x01,0x00,0x01,0x22};
20  uint8_t oneShotFastDistMeasure[9] =    {0xAA,0x00,0x00,0x20,0x00,0x01,0x00,0x02,0x23};
21  uint8_t continuousAutoDistMeasure[9] = {0xAA,0x00,0x00,0x20,0x00,0x01,0x00,0x04,0x25};
22  uint8_t continuousSlowDistMeasure[9] = {0xAA,0x00,0x00,0x20,0x00,0x01,0x00,0x05,0x26};
23  uint8_t continuousFastDistMeasure[9] = {0xAA,0x00,0x00,0x20,0x00,0x01,0x00,0x06,0x27};
24  //*************************************************************************
25  //* SET BAUD
26  //*************************************
27  void setBaud(void)
28  {
29      cmdPkt[0] = 0x55;
30      uart_putc(UART1_ID,cmdPkt[0]);
31  }
32  //*************************************************************************
33  //* START 1-SHOT SLOW MEASURE
34  //*************************************************************************
35  void startOneShotSlowMeasure(void)
36  {
37      memcpy(cmdPkt,oneShotSlowDistMeasure,sizeof(oneShotSlowDistMeasure));
38      for(uint8_t i = 0; i < sizeof(oneShotSlowDistMeasure); i++)
39      {
40          uart_putc(UART1_ID,cmdPkt[i]);
41      }
42  }
```

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x01	0x00	0x00	0x21

tofClient.c – Merge ToF and TCP Client Functionality

C tofClient.c

```
221
222     while(!state->complete)
223     {
224         cyw43_arch_poll();
225         sleep_ms(1);
226         startOneShotSlowMeasure();
227         while(!CharInRing());
228         busy_wait_ms(10);
229         bufIndx = 0;
230         do{
231           rxBuf[bufIndx++] = readring();
232         }while(CharInRing());
233         txBuf[0] = rxBuf[6];
234         txBuf[1] = rxBuf[7];
235         txBuf[2] = rxBuf[8];
236         txBuf[3] = rxBuf[9];
237         err_t err = tcp_write(state->tcp_pcb, txBuf, 0x04, TCP_WRITE_FLAG_COPY);
238
239     }
240     cyw43_arch_deinit();
241     return 0;
242 }
```

Bytes	0	1	2	3	4	5	6:9	10:11	8
Name	**Head**	**RW/ Address**	**Register**		Payload count		Payload Distance	Payload SQ	Check sum
Data	0xAA	0x00	0x00	0x22	0x00	0x03	0xAABBCCDD	0x0101	Check sum

tofClient.c – Merge ToF and TCP Client Functionality

Serial Input/Output Monitor

File Edit View Configuration

ASCII HEX ASCII Send HEX Send Line Status Clear Terminal Columns Displ

Input/Output Viewing Option

```
 00Version: 7.95.49 (2271bb6 CY) CRC: b7a28ef3 Da
: 1043.2162 FWID 01-c51d9400
cyw43 loaded ok, mac 28:cd:c1:00:ae:f3
API: 12.2
Data: RaspberryPi.PicoW
Compiler: 1.29.4
ClmImport: 1.47.1
Customization: v5 22/06/24
Creation: 2022-06-24 06:55:08
Connecting to WiFi...
connect status: joining
connect status: no ip
connect status: link up
Connected.
Connecting to 192.168.1.235 port 8088
AA0000220003000000090002FE4AA0000220003000000900
Waiting for buffer from server
AA0000220003000000090002DE2
tcp_client_sent 8
```

```
63 6F 6E 6E 65 63 74 20 73 74 61 74 75 73 3A 20 6A 6F 69 6E 69 6E 67
63 6F 6E 6E 65 63 74 20 73 74 61 74 75 73 3A 20 6E 6F 20 69 70 0D 0A
63 6F 6E 6E 65 63 74 20 73 74 61 74 75 73 3A 20 6C 69 6E 6B 20 75 70
43 6F 6E 6E 65 63 74 65 64 2E 0D 0A
43 6F 6E 6E 65 63 74 69 6E 67 20 74 6F 20 31 39 32 2E 31 36 38 2E 31
41 41 30 30 30 30 32 32 30 30 30 33 30 30 30 30 30 39 30 30 30 32
30 30 30 30 39 30 30 30 33 30 45 35 0D 0A
57 61 69 74 69 6E 67 20 66 6F
41 41 30 30 30 30 32 32 30 30
74 63 70 5F 63 6C 69 65 6E 74
```

tcp_client_sent callback

ASCII toftof

HEX

Send

COM6 8N1 115200 R 0 C 0 R22 C 1 Disconnect

```
 00Version: 7.95.49 (2271bb6 CY) CRC: b7a28ef3 Date:
: 1043.2162 FWID 01-c51d9400
cyw43 loaded ok, mac 28:cd:c1:00:ae:f3
API: 12.2
Data: RaspberryPi.PicoW
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Connecting to WiFi...
connect status: joining
connect status: no ip
connect status: link up
Connected.
Connecting to 192.168.1.235 port 8088
AA0000220003000000090002FE4AA0000220003000000900030E5
Waiting for buffer from server
AA0000220003000000090002DE2
tcp_client_sent 8
```

distance in mm

tcp_client_connected callback

tofClient.c – Merge ToF and TCP Client Functionality

Serial Input/Output Monitor

File Edit View Configuration

ASCII HEX ASCII Send HEX Send Line Status Clear Terminal Input/Output

Columns Display Viewing Options

Data Graph Tools

Ribbon Classic Menu Style

```
ClmImport: 1.47.1
Customization: v5 22/06/24
Creation: 2022-06-24 06:55:08
Connecting to WiFi...
connect status: joining
connect status: no ip
connect status: link up
Connected.
Connecting to 192.168.1.235 port 8088
AA000022000300000090002FE4AA000022000300000090030E5
Waiting for buffer from server
AA000022000300000090002DE2
tcp_client_sent 8
AA000022000300000900031E6
tcp_client_sent 4
AA000022000300000090002DE2
tcp_client_sent 4
AA000022000300000090002ADF
tcp_client_sent 4
AA000022000300000090002EE3
tcp_client_sent 4
AA000022000300000900031E6
tcp_client_sent 4
```

tcp_client_sent callback

```
41 41 30 30 30 30 32 32 30 30 30 33 30 30 30 30 30 30 39 30 30 30 33 31 45 36 0D 0A
74 63 70 5F 63 6C 69 65 6E 74 5F 73 65 6E 74 20 34 0D 0A
41 41 30 30 30 30 32 32 30 30 30 33 30 30 30 30 30 30 39 30 30 30 32 44 45 32 0D 0A
74 63 70 5F 63 6C 69 65 6E 74 5F 73 65 6E 74 20 34 0D 0A
41 41 30 30 30 30 32 32 30 30 30 33 30 30 30 30 30 30 39 30 30 30 32 41 44 46 0D 0A
74 63 70 5F 63 6C 69 65 6E 74 5F 73 65 6E 74 20 34 0D 0A
41 41 30 30 30 30 32 32 30 30 30 33 30 30 30 30 30 30 39 30 30 30 32 45 45 33 0D 0A
74 63 70 5F 63 6C 69 65 6E 74 5F 73 65 6E 74 20 34 0D 0A
41 41 30 30 30 30 32 32 30 30 30 33 30 30 30 30 30 30 39 30 30 30 33 31 45 36 0D 0A
74 63 70 5F 63 6C 69 65 6E 74 5F 73 65 6E 74 20 34 0D 0A
```

ASCII toftof Send

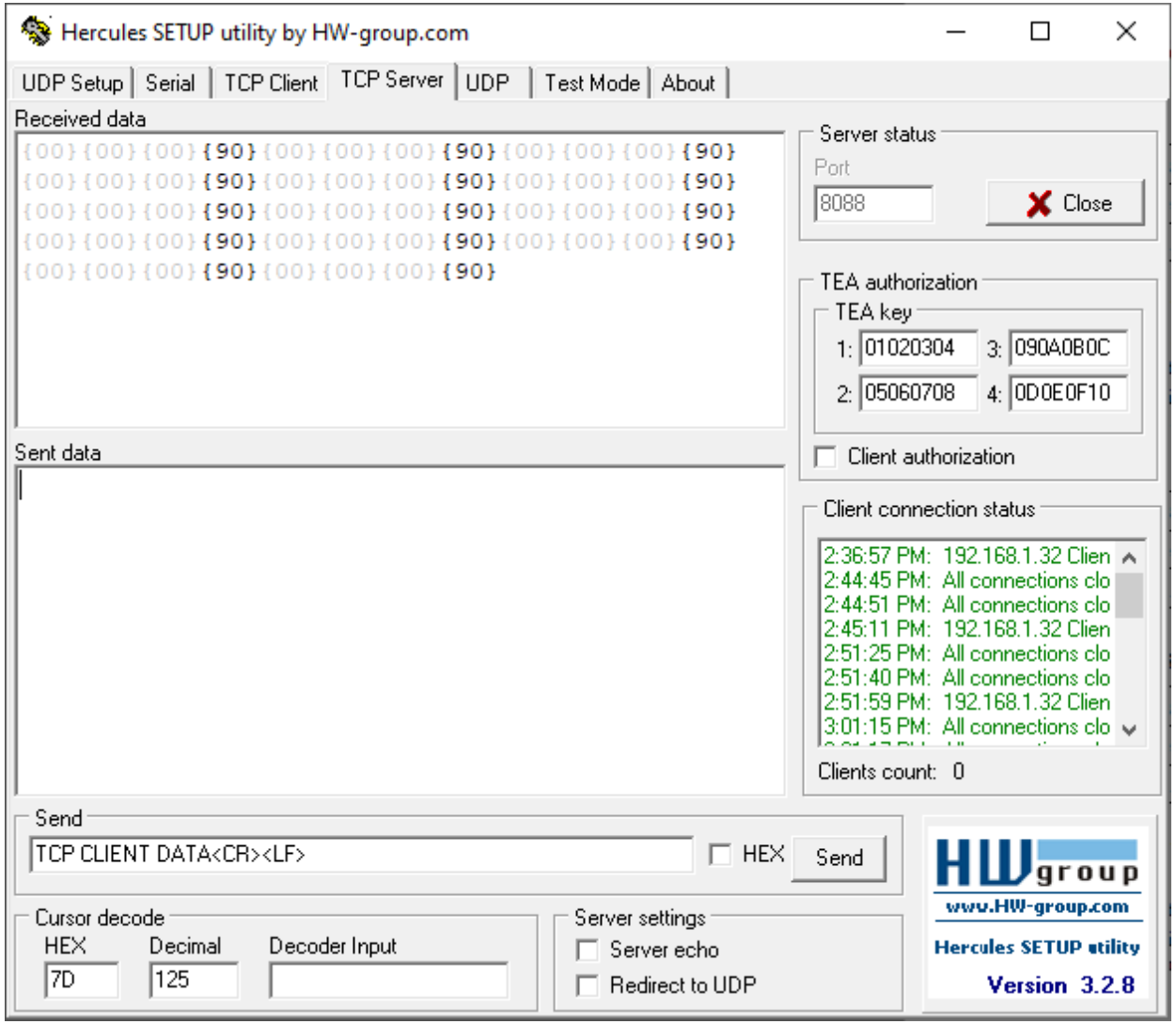
HEX Send

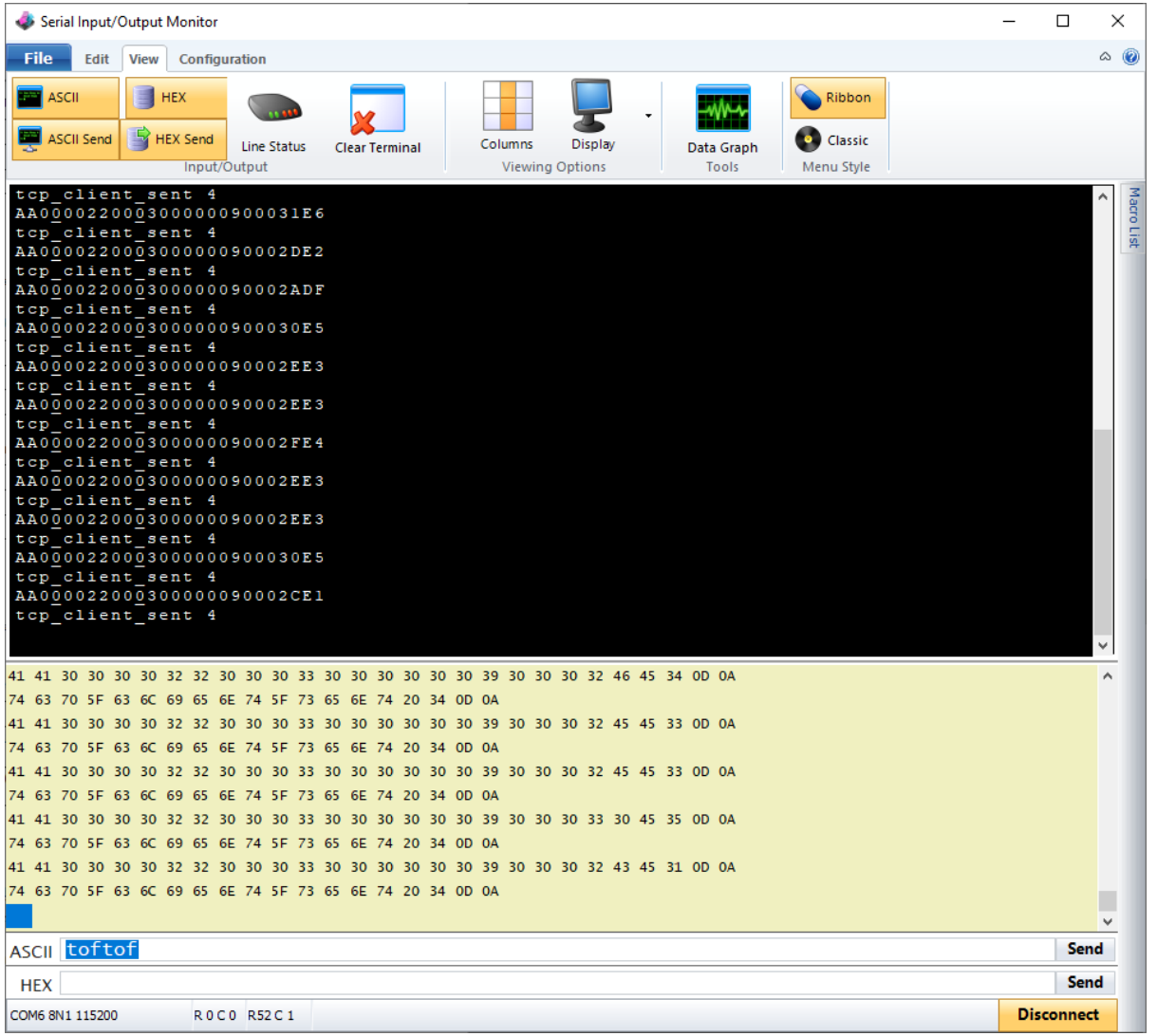
COM6 8N1 115200 R 0 C 0 R32 C 1 Disconnect

```
ClmImport: 1.47.1
Customization: v5 22/06/24
Creation: 2022-06-24 06:55:08
Connecting to WiFi...
connect status: joining
connect status: no ip
connect status: link up
Connected.
Connecting to 192.168.1.235 port 8088
AA000022000300000090002FE4AA000022000300000090030E5
Waiting for buffer from server
AA000022000300000090002DE2
tcp_client_sent 8
AA000022000300000900031E6
tcp_client_sent 4
AA000022000300000090002DE2
tcp_client_sent 4
AA000022000300000090002ADF
tcp_client_sent 4
AA000022000300000090002EE3
tcp_client_sent 4
AA000022000300000900031E6
tcp_client_sent 4
```

distance in mm

tofClient.c – Merge ToF and TCP Client Functionality





Thank you for attending!!!

Please consider the resources below:

- raspberrypi.org
- RP2040 Datasheet
- Raspberry Pi Pico C/C++ SDK
- SEGGER J-Link
- SEGGER Ozone Debugger
- lwIP API Documentation
- JRT Meter Technology

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