

## 1 Description

CambridgeIC’s CTU and resonant inductive encoder ICs measure the position of contactless, inductively coupled targets relative to sensors.

These ICs include an SPI interface. This may be used to configure them, update on-chip Application Code, initiate measurements and communicate results to a host.

Unlike CambridgeIC’s CTU Adapter, the Streaming Adapter captures measurements over SPI at the maximum rate possible for each IC. It can efficiently stream results over USB, to make them available to software running on a connected PC.

To achieve the high sample rates necessary, the Streaming Adapter includes a dual core ARM M0+ Cortex processor: the RP2040 from Raspberry Pi. Code running on one of these processor cores acts as the host system for ICs connected over SPI. It performs the fast, low-level operations needed to obtain measurement results and program ICs with new Application Code.

The Streaming Adapter’s code for communicating with and operating a connected IC is written to act as sample code, and is available to customers upon request.

Customers may use the Streaming Adapter hardware for the development of their own host software. It is based on a Raspberry Pi Pico microcontroller board. This means it is widely supported with development tools available from other parties.

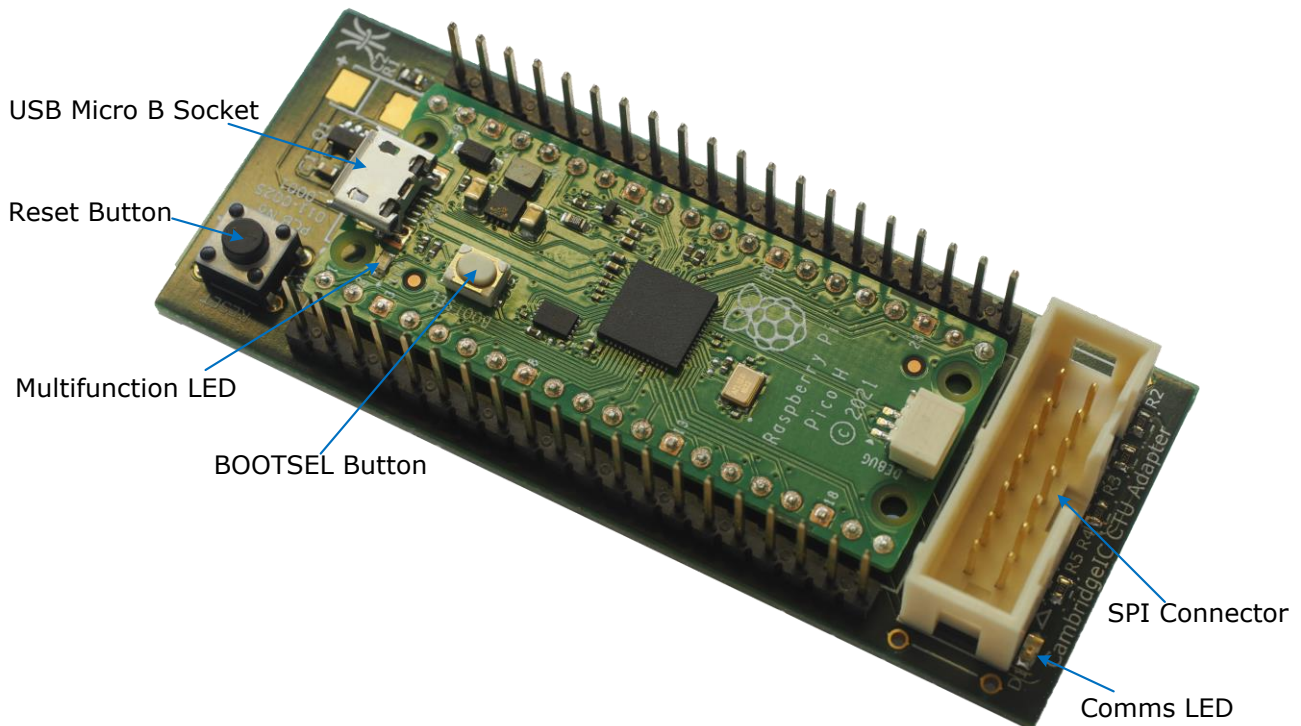
## Applications

- Connecting ICs to a PC for demos and evaluation
- Programming and configuring ICs
- Prototyping and evaluation of host software

The Streaming Adapter is NOT compatible with CambridgeIC CTU Software. Supported applications currently include:

- CTU Streaming Demo, for taking, viewing and analysing CTU chip measurements
- Firmware Update, for updating IC Application Code

Product identification	
Part no.	Description
013-7006	Streaming Adapter including SPI and USB Cables



**Figure 1 Streaming Adapter**

## 2 Board Layout

The Streaming Adapter is illustrated in Figure 1. It comprises a Raspberry Pico microcontroller board mounted onto a base board. The base board includes a small number of components to customise it for the Streaming Adapter application.

### 2.1 Connectors

SPI Connector P3 is a 14-way header for connecting to a CambridgeIC Development Board. It includes SPI interface, power and user I/Os. Its pin-out is shown in Table 1.

**Table 1 Pin-Out of SPI Connector P4**

Pin	Signal	Description
1	VSUPPLY	+3.3V supply out
2	GND	Supply voltage return (0V)
3	IO1	User I/Os
4	IO2	
5	IO3	
6	IO4	
7	GND	Supply voltage return (0V)
8	MOSI	Master Out Slave In output
9	nSS	Slave Select output
10	SCK	Serial Clock output
11	MISO	Master In Serial Out input
12	IO5	User I/Os
13	IO6	
14	nRST	Reset output, active low

The Raspberry Pico microcontroller board includes a USB Micro B socket for connection to a PC.

### 2.2 Switches

A Reset Button causes a reset of the Streaming Adapter's processor, which in turn pulls nRST low to reset a connected IC as well. The Reset Button has the same effect as unplugging the Streaming Adapter's USB connection.

A BOOTSEL Button on the Raspberry Pico microcontroller board is used when the Streaming Adapter's Code requires updating (section 3.2).

### 2.3 LEDs

The base board includes a Comms LED D1, which lights when the Streaming Adapter is communicating over USB.

The Raspberry Pico microcontroller board includes a Multifunction LED whose application is flexible depending on the application.

## 3 Operation

### 3.1 Windows Installation

The Streaming Adapter should install automatically when connected to a Windows PC over USB. It appears as a COM Port. To verify installation, check that a new COM port appears in Device Manager.

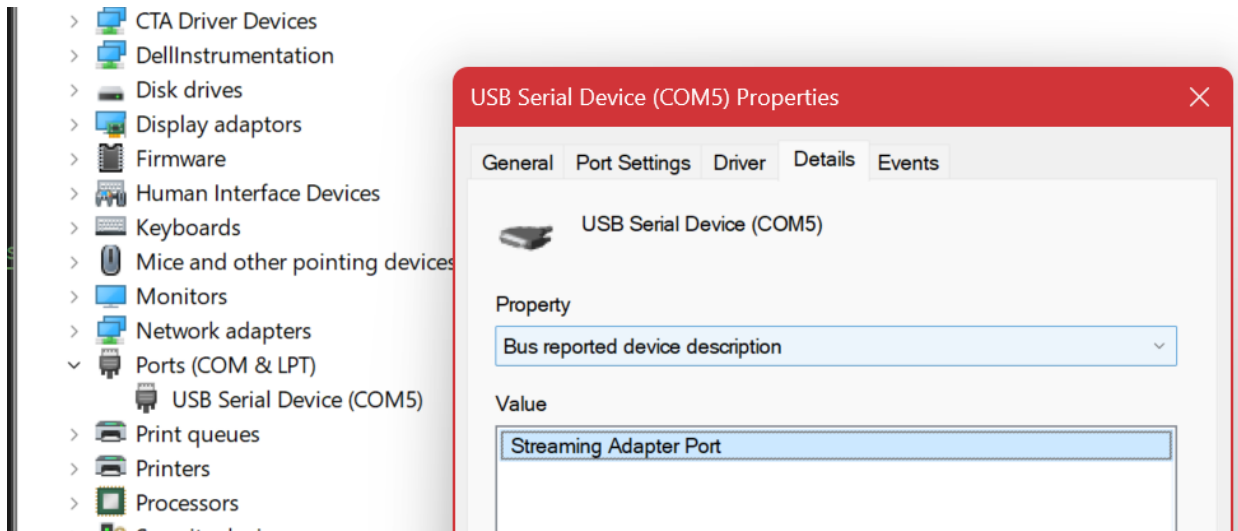


Figure 2 Device Manager screen shot

If there are multiple COM Port devices connected to the PC, it may be difficult to distinguish them. The PC gives each a number, however it may be difficult to establish which number corresponds to which device. The Streaming Adapter may be identified by its "Bus reported device description", which is set to "Streaming Adapter Port". To make this property visible in Device Manager, double click on a USB Serial Device in Device Manager. Select the "Details" tab. Then use the drop down box under "Property" to select "Bus reported device description". When the Streaming Adapter's COM Port is selected, expected results are shown in Figure 2.

### 3.2 Code Update Process

The Streaming Adapter includes code running on a Raspberry Pi Pico's ARM M0+ Cortex processor. This code is distributed in USB Flashing Format, as a file with a .uf2 extension. To update the code running on the Streaming Adapter:

- Connect the Streaming Adapter to a PC over USB.
- Press and hold the Reset Button.
- Press and hold the BOOTSEL button.
- Release the Reset Button, then wait a couple of seconds.
- Release the BOOTSEL button.

This process makes the Streaming Adapter appear as a USB drive connected to the PC. The PC will give it a new drive letter. Use File Manager to open the new drive. Open another instance of File Manager and navigate to the directory location where the new .uf2 file is stored. Drag and drop the .uf2 file onto the Streaming Adapter's File Manager window, as if a normal file is being copied to a USB stick. The Streaming Adapter should quickly reboot running the new firmware. The drive letter should disappear from the PC, and the COM port should reappear.

If the Streaming Adapter is in the state where it appears as a USB drive connected to the PC, it is possible to return to normal operation without updating its code by pressing and releasing the Reset Button.

## 4 Schematic

Figure 3 is a schematic for the Streaming Adapter. It is built around a Raspberry Pi Pico microcontroller board. The base board includes only minimal circuitry:

- The Reset Switch, which pulls the Raspberry Pi Pico's RUN line low when pressed.
- The Comms LED, which lights when the Raspberry Pi Pico's GP15 line is high.
- Pull-ups on MISO, IO5 and IO6.
- A buffer IC for generating an nRST signal for resetting the connected IC, including when the Raspberry Pi Pico is held in reset. In this case GP26 (nPRST) is pulled low by a weak pull-down, and the buffer serves to boost the current capacity of this signal.
- Connector P3, whose pinout includes SPI, IOs and power. This is compatible with CambridgeIC Development Boards including for the CAM312, CAM502 and CAM204 chips.

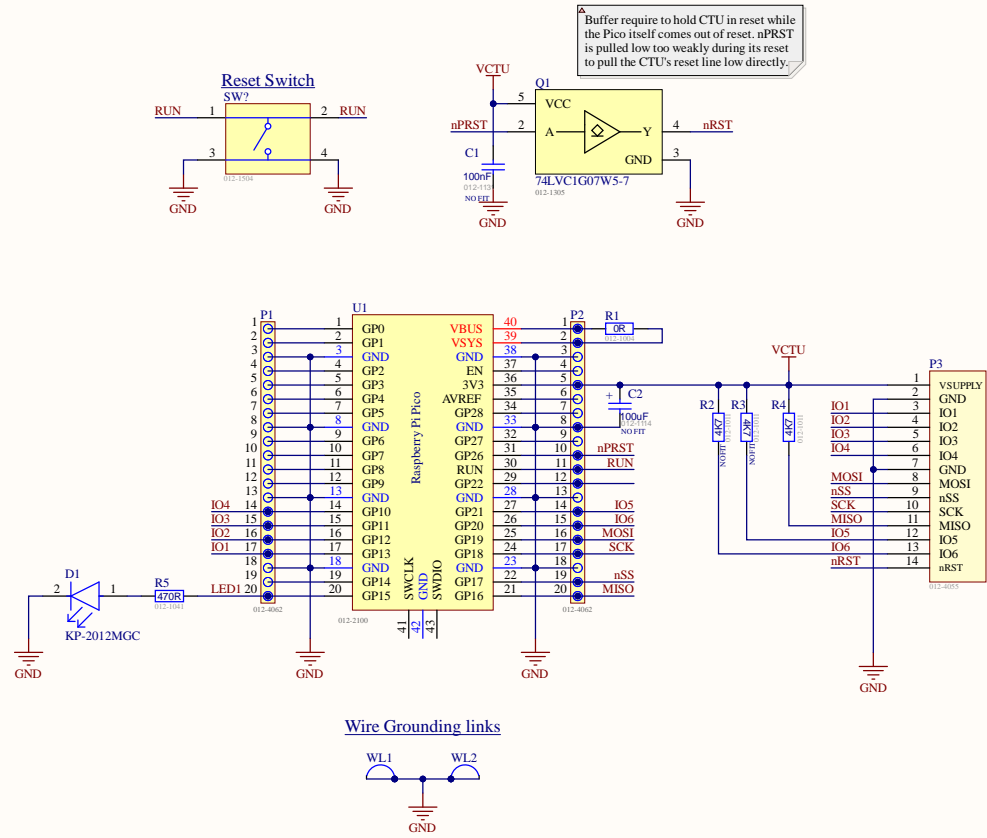


Figure 3 Streaming Adapter Schematic

Title			RPI Pico Adapter Board		
Size	Number	Revision			
A3	013-5040	0001(draft)			
Date:	8/31/2022	Sheet of			
File:	D:\cic\013-5040_0001.SchDoc	Drawn By:			

## 5 Document History

Revision	Date	Reason
0001	5 Jan 2023	First draft
0002	2 May 2023	Removed CONFIDENTIAL marking and details

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