GWU2X Programming Guide_U2X_SPI

UG1004-1.0E, 6/29/2021

Disclaimer

GOWINSEMI assumes no liability and provides no warranty (either expressed or implied) and is not responsible for any damage incurred to your hardware, software, data, or property resulting from usage of the materials or intellectual property except as outlined in the GOWINSEMI Terms and Conditions of Sale. All information in this document should be treated as preliminary. GOWINSEMI may make changes to this document at any time without prior notice. Anyone relying on this documentation should contact GOWINSEMI for the current documentation and errata.

Revision History

Date	Version	Description
6/29/2021	1.0E	Initial version published.

Contents

List of Figures

List of Tables

1 General Description

GWU2X is a USB to multiple protocol converter that enables SCLK function conversion and supports up to 12MHz SCLK clock frequency (current test result).

It supports standard SPI host mode; It supports full duplex data transceiver function, optional command fields, address fields, DummySCLK fields, and data fields.

2 Driver Installation and Uninstallation

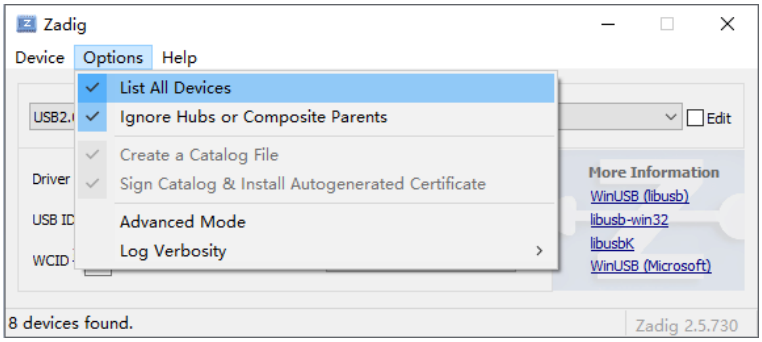
GWU2X_SPI can be programmed using libusb, the open source USB function library. To program with this function library, the “WinUSB.sys” USB driver program needs to be installed.

You can use Zadig(https://zadig.akeo.ie/), the open source driver installation tool, to install driver. The driver installation requires administrator privileges.

2.1 Use Zadig to Install Driver

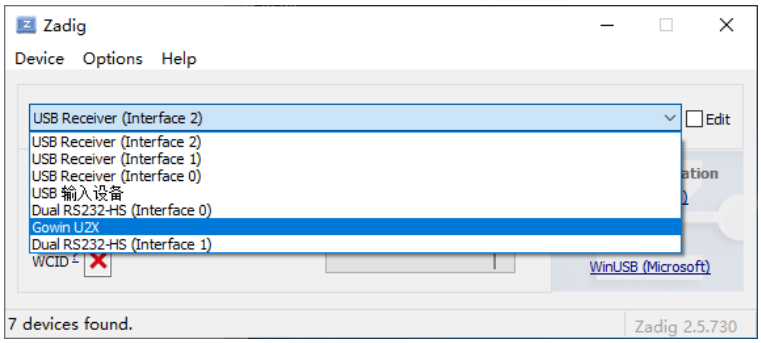
Connect GWU2X device to the computer USB interface, double-click to open Zadig (administrator privileges required), click Options, and check the "List All Device" option. All USB devices connected to the computer will be listed.

Figure 2-1 Check “List All Device” Option



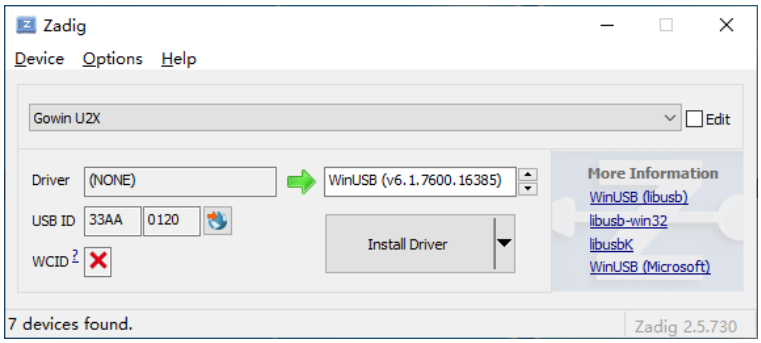
Select GWU2X, the device that requires driver installation.

Figure 2-2 Select the Device that Requires Driver Installation



Select the driver to be installed, use libusb+WinUSB, and select WinUSB.

Figure 2-3 Select the Driver Program to be Installed



Click “Install Driver”. The driver will be installed after a few moments.

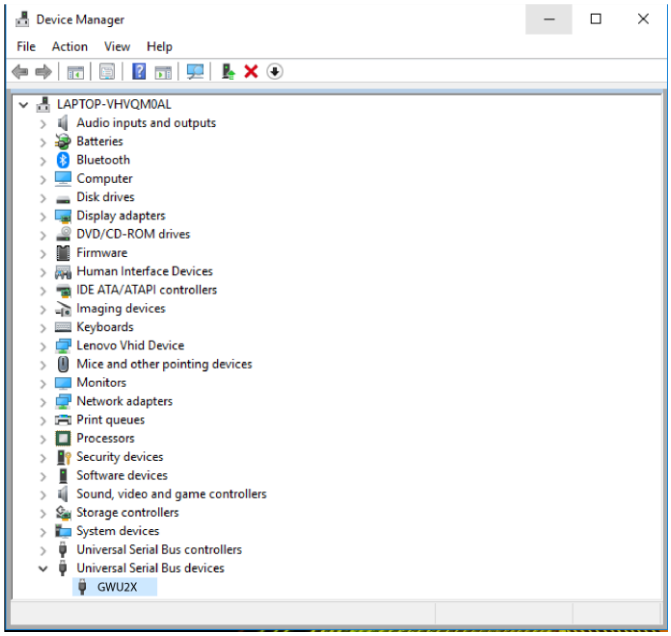
Note!

The button displays "Install Driver" if the driver is not currently installed, and "Replace Driver" if another driver is currently installed.

2.2 Uninstall Driver

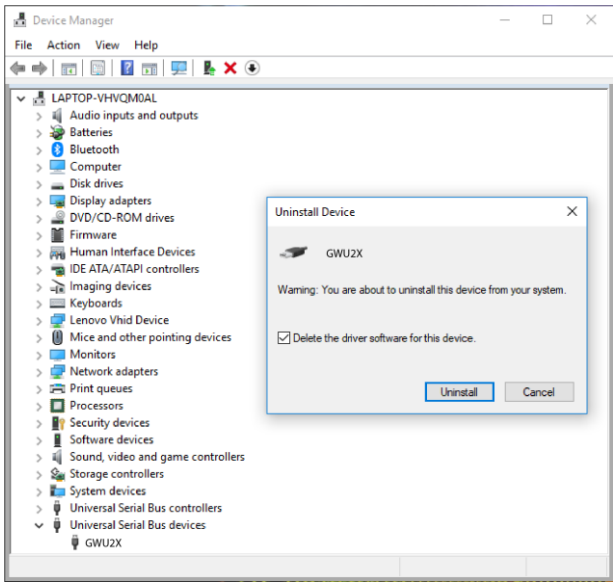
To uninstall the driver, connect GWU2X device to the computer, open the windows device manager, and find GWU2X device in the "Universal Serial Bus Devices" list. Right-click on the device name and select the "Uninstall Device" option in the pop-up menu.

Figure 2-4 Open Device Manager



In the pop-up dialog box, first check "Remove driver software for this device", and then click the “Uninstall” button to uninstall the driver.

Figure 2-5 Uninstall Device



3 libusb_WinUSB Programming

libusb is an open source USB function library.

The official website is: https://libusb.info

The source code is hosted on github at: https://github.com/libusb/libusb

You can download the pre-compiled version, the official GCC version and VS version, including dynamic and static libraries, through the official website. You can also download the source code through github and compile it on your own.

For libusb function descriptions, see the official reference at: http://libusb.sourceforge.net/api-1.0

3.1 Libusb Initialization and Exit

When programming with libusb, you need to call the function libusb_init() to initialize it first, and at the end of use, you should call the function libusb_exit() to exit it from the system.

Function declarations are as follows:

```
int libusb_init (libusb_context ** context)

void libusb_exit (libusb_context * ctx)
```

The parameter libusb_context is a libusb context struct that saves some configuration parameters for libusb. If libusb_context is not specified, a default context struct will be created, or if one already exists, it will be used directly and not reinitialized.

Programming examples are as follows:

```
int rc = libusb_init(NULL);

if (rc < 0)

    return rc;
```

```
libusb_exit(NULL);
```

3.2 Open the Specified USB Device

You can use the libusb_open_device_with_vid_pid() function to open the specified device based on VID/PID. You can also use the libusb_get_device_list() function to get all the USB devices, select the desired device from them, and use the libusub_open() function to get the handle of the device for subsequent operations. The function declaration is as follows:

Open the device with VID/PID:

```
libusb_device_handle* libusb_open_device_with_vid_pid(
   libusb_context * ctx,
   uint16_t vendor_id,
   uint16_t product_id
);
```

The parameter ctx is the address of the context struct generated when initializing libusb. If the default context is used, use NULL. vendor_id and product_id are the VID and PID of the USB device, respectively. The VID of Gowin USB device is 0x33aa, and the PID of the U2X_SPI device is 0x0020.

The return value is the pointer to the operation handle of the first matching device found by libusb on this computer, otherwise it returns the null pointer NULL.

Examples of use are as follows:

```
devh = libusb_open_device_with_vid_pid(NULL, 0x33aa, 0x0020);
if(NULL == devh) {
   printf("Open USB device failed\n");
   goto out;
}
```

Select the specified device after getting all USB devices.

```
ssize_t libusb_get_device_list (
   libusb_context * ctx,
   libusb_device *** list
)
```

The parameter ctx is the address of the context struct generated when initializing libusb. If the default context is used, use NULL. “list” is the pointer to storage device list.

At the end of use, the memory should be freed using the libusb_free_device_list() function.

If the function is executed correctly, the return value is the number of devices and the list saves the list of found devices. Otherwise, a libusb_error value less than zero is returned.

```
int libusb_open (
    libusb_device *dev,
    libusb_device_handle **dev_handle
    )
```

The parameter dev is the device in the device list, and dev_handle is the address that saves the pointer of the returned device handle.

If the device is opened successfully, the return value is zero, otherwise an libusb_error value less than zero is returned.

Examples of use are as follows:

```
cnt = libusb_get_device_list(NULL, &devs);
if(cnt < 0) {
    // get device list failed
    return -1;
}
for(int i = 0; i < cnt; i++) {
    libusb_open(dev[i], dev_handle);
    if(/*the wanted device is opened*/) {
        break;
    } else {
        //the current device is not wanted, close it and check the next one.
        libusb_close(dev_handle);
    }
}
```

3.3 Interface Declaration

USB devices usually contain one or more interfaces. libusb needs to declare the interface first when using the interface, and when the declaration is successful, it means that the interface is successfully opened and the endpoint contained in the interface can be received/transmitted.

```
int libusb_claim_interface(
    libusb_device_handle * dev_handle,
    int interface_number
)
```

The parameter dev_handle is the device handle; interface_number is the number of interface. In GWU2X device, the interface number is 0. If the interface is declared successfully, the return value is zero, otherwise an libusb_error value less than zero is returned.

Programming Examples:

```
rc = libusb_claim_interface(devh, 0);
if (rc < 0) {
    printf("Error claiming interface: %s\n", libusb_error_name(rc));
    goto out;
}
```

4 Parameter Configuration

The struct of u2x_spi_config is used to configure and control the transmission of U2X_SPI parameters.

```
typedef struct _u2x_spi_config_{

    unsigned int          uiSclkFreqKiloHz;

    data_shift_direction  DataShftDir;

    sclk_polarity         ClkPol;

    sclk_phase            ClkPha;

    sel_polarity          SelPol;

    unsigned char         ucAddrLen;

    unsigned char         ucCmdEn;

} u2x_spi_config;
```

- uiSclkFreqKiloHz: Used to configure SCLK clock Frequency, in Khz;
- DataShftDir: Used to control the data shift mode. Set it to MSB_FIRST if high is first; set it to LSB_FIRST if low is first.
- ClkPol: Used to set the level of the SCLK clock during idle time. If it is low, set it to CPOL_0; if it is high, set it to CPOL_1.
- ClkPha: Set which edge of SCLK to send data and sample the received data. If send and sample on the first edge, set it to CPHA_0; if send and sample on the second edge, set it to CPHA_1.
- SelPol: Used to set the effective level of the chip select signal. Set it to SEL_POL_LO if the low level is valid; set it to SEL_POL_HI if the high level is valid.
- ucAddrLen: Used to control the length of the address segment to be sent. If it is not necessary to send the address segment, set this parameter to

0. The maximum value of this parameter is 4, indicating that the length of the address segment is 4 bytes.

- ucCmdEn: Used to control whether to send a command segment. If set to 1, send a byte of the command segment; if set to 0, no command segment will be sent and the length of the command segment is fixed at 1 byte.

Please refer to the following enumeration variable definitions for values set above:

```
typedef enum _data_shift_direction_ {
      MSB_FIRST,
      LSB_FIRST
} data_shift_direction;

typedef enum _sclk_polarity_ {
      CPOL_0,
      CPOL_1
} sclk_polarity;

typedef enum _sclk_phase_ {
      CPHA_0,
      CPHA_1
} sclk_phase;

typedef enum _sel_polarity_ {
      SEL_POL_LO,
      SEL_POL_HI
} sel_polarity;
```

5 U2X_SPI API Functions

5.1 Parameter Configuration

This funtion is uesd to configure U2X_SPI parameters. If you need to change the parameter configuration, use this function again to reconfigure it.

```
int u2x_spi_set_config(

    libusb_device_handle *devh,

    u2x_spi_config *pSpiConfig,

    unsigned int uiTimeout

);
```

Parameters:

- devh: device handle of libusb;
- pSpiConfig: A pointor to the “u2x_spi_config” struct, use this struct to configure parameters for U2X_SPI device.
- uiTimeout: timeout parameter, in milliseconds;

Return Value:

Returns 0 if the function runs successful, otherwise an error code less than zero is returned.

5.2 Send / Receive Byte Data

This function can realize three data transmission modes of full duplex sending and receiving, sending only, and receiving only. It takes bytes as unit, and the maximum data length of a single transmission is 512 bytes.

```
int u2x_spi_read_write_bytes(

    libusb_device_handle *devh,
```

```
    unsigned int uiDataByteCnt,
    unsigned char *pucWriteData,
    unsigned char *pucReadData,
    unsigned int uiAddr,
    unsigned char ucCmd,
    unsigned int uiDummyCnt,
    u2x_spi_config *pSpiConfig,
    unsigned int uiTimeout
);
```

Parameters:

- devh: device handle of libusb;
- uiDataByteCnt: The count of bytes to control the data transmitting and receiving.
- pucWriteData: A pointer to that holds the data to be transmitted. If no data needs to be sent, set this parameter to NULL.
- pucReadData: A pointer to that holds the received data. If no data needs to be received, set this parameter to NULL.
- uiAddr: Address segment data. If the length of the address segment configuration is non-zero, the address data will be sent. The maximum length of the address segment is 4 bytes.
- ucCmd: Command segment data. If it's enabled, the byte data will be sent in the command segment.
- uiDummyCnt: DummySCLK, that is, the number of waiting clock cycles between the command segment, address segment, and data segment. If this parameter is non-zero, send the SCLK with the specified number of cycles after sending the command segment and address segment, and then send the data segment. The maximum value of this parameter is 65536. If DummySCLK segment is not needed, set this parameter to 0.
- pSpiConfig: A pointor to the "u2x_spi_config" struct, use this struct to control the reading and writing of U2X_SPI device.
- uiTimeout: timeout parameter, in milliseconds;

Return Value:

Returns 0 if the function runs successful, otherwise an error code less

than zero is returned.

5.3 Send / Receive Multiple Bits of Data

This function can realize three data transmission modes of full duplex sending and receiving, sending only, and receiving only. It takes bits as unit. The maximum data length of a single transmission is 2048 bits (512 bytes).

```
int u2x_spi_read_write_bits(
    libusb_device_handle *devh,
    unsigned int uiDataBitCnt,
    unsigned char *pucWriteData,
    unsigned char *pucReadData,
    unsigned int uiAddr,
    unsigned char ucCmd,
    unsigned int uiDummyCnt,
    u2x_spi_config *pSpiConfig,
    unsigned int uiTimeout
);
```

Parameters:

- devh: device handle of libusb;
- uiDataBitCnt: The count of bits to control the data transmitting and receiving.
- pucWriteData: A pointer to that holds the data to be transmitted. If no data needs to be sent, set this parameter to NULL.
- pucReadData: A pointer to that holds the received data. If no data needs to be received, set this parameter to NULL.
- uiAddr: Address segment data. If the length of the address segment configuration is non-zero, the address data will be sent. The maximum length of the address segment is 4 bytes.
- ucCmd: Command segment data. If it's enabled, the byte data will be sent in the command segment.
- uiDummyCnt: DummySCLK, that is, the number of waiting clock cycles between the command segment, address segment, and data segment. If this parameter is non-zero, send the SCLK with the specified number

of cycles after sending the command segment and address segment, and then send the data segment. The maximum value of this parameter is 65536. If DummySCLK segment is not needed, set this parameter to 0.

- pSpiConfig: A pointor to the “u2x_spi_config” struct, use this struct to control the reading and writing of U2X_SPI device.
- uiTimeout: timeout parameter, in milliseconds;

Return Value:

Returns 0 if the function runs successful, otherwise an error code less than zero is returned.

5.4 Programming Example

```
//Global variables

static struct libusb_device_handle *devh = NULL;

static u2x_spi_config SpiConfig;

u2x_spi_config *pSpiConfig = &SpiConfig;

// Main Function

int main(int argc, char *argv[])

{

   unsigned char ucWrData[64];

   unsigned char ucRdData[64];

   unsigned long long ullWrData = 0x1234567812345678;

   unsigned long long ullRdData = 0x0;

int rc = 0;

rc = libusb_init(NULL);

if (rc < 0)

  return rc;

     // Open the GWU2X device

devh = libusb_open_device_with_vid_pid(NULL, 0x33aa, 0x0120);

if(NULL == devh) {

printf("Open USB device failed\n");

goto out;
```

```
}
rc = libusb_claim_interface(devh, 0);
if (rc < 0) {
  goto out;
}
for(i = 0; i < DATA_BYTE; i++) {
  ucWrData[i] = i;
}
// Configure U2X_SPI parameters
pSpiConfig->DataShftDir      = MSB_FIRST;
pSpiConfig->ClkPol           = CPOL_0;
pSpiConfig->ClkPha           = CPHA_0;
pSpiConfig->SelPol           = SEL_POL_LO;
pSpiConfig->uiSclkFreqKiloHz  = 10000; // SCLK frequency is 10MHz
pSpiConfig->ucAddrLen        = 3; // The length of adress segment is 3 bytes
pSpiConfig->ucCmdEn          = 1;  // Enable command segment
u2x_spi_set_config(devh, pSpiConfig, 1000);

//Full-duplex mode sends and receives 64 bytes of data simultaneously
u2x_spi_read_write_bytes(devh,
    64,  // The length of transmission data is 64 bytes.
    ucWrData, // Data to be sent
    ucRdData, // Store the received data
    0xaabbcc, // The address segment is 0xaabbcc
    0x32, // The Command segment is 0x32
    8,        // Send eight cycles of Dummy SCLK after command segment and adress
segment
    pSpiConfig, // Pointer to the struct of parameter configuration
    1000);// Set “timeout” parameter to 1000 milliseconds

     //Full-duplex mode sends and receives 56 bits data simultaneously
```

```
u2x_spi_read_write_bits(devh,
    56,  // The length of transmission data Bit 56 bits.
    (unsigned char *)(&ullWrData), // Data to be sent
    (unsigned char *)(&ullRdData), // Store the received data
    0xaabbcc, // The address segment is 0xaabbcc
    0x32, // The Command segment is 0x32
    8,    // Send eight cycles of Dummy SCLK after command segment and adress
segment
    pSpiConfig, // Pointer to the struct of parameter configuration
    1000);// Set “timeout” parameter to 1000 milliseconds


// Close the device and Exit
out:
if(devh)
  libusb_close(devh);
libusb_exit(NULL);
return 0;
    }
```

6 Error Code

If the API function runs well, it returns 0; otherwise, it returns a negative number.

The meaning of the non-zero return values are shown in the table as below.

Table 6-1 Error Code List

Value	Enumerator	
0	SUCCESS	Runs correctly
-1	USB_ERROR_IO	USB input/output error
-2	USB_ERROR_INVALID_PARAM	USB parameter error
-3	USB_ERROR_ACCESS	No permission to access the device
-4	USB_ERROR_NO_DEVICE	No USB device (device disconnected)
-5	USB_ERROR_NOT_FOUND	No Entity
-6	USB_ERROR_BUSY	USB device busy
-7	USB_ERROR_TIMEOUT	Timeout
-8	USB_ERROR_OVERFLOW	Memory overflow
-9	USB_ERROR_PIPE	Pipe error
-10	USB_ERROR_INTERRUPTED	The system function was interrupted
-11	USB_ERROR_NO_MEM	Out of memory
-12	USB_ERROR_NOT_SUPPORTED	Not supported on the current platform
-13	U2X_SPI_ERROR_USBTRANS_ERR	USB data transmitting error
-14	U2X_SPI_ERROR_INVALID_PARAM	Invalid parameter setting
-15	U2X_SPI_ERROR_TIMEOUT	U2X_SPI transmitting timeout

Value	Enumerator	
-16	U2X_SPI_ERROR_CMD_ERR	U2X_SPI command error
-99	ERROR_OTHER	Other errors

Terminology and Abbreviations

The abbreviations and terminology used in this manual are as shown in Table A -1.

Table A -1 Terminology and Abbreviations

Terminology and Abbreviations	Full Name
USB	Universal Serial Bus
SPI	Serial Peripheral Interface

Support and Feedback

Gowin Semiconductor provides customers with comprehensive technical support. If you have any questions, comments, or suggestions, please feel free to contact us directly by the following ways.

Website: www.gowinsemi.com

E-mail:support@gowinsemi.com


GOWIN
PROGRAMMING FOR THE FUTURE