

# **Application Note**

# AN\_435

# FT602 UVC Chip Configuration Guide

Version 1.2

Issue Date: 2017-12-08

This document provides a guide on how to use the FT602 Chip Configuration Programmer application for customizing the chip configuration.

Use of FTDI devices in life support and/or safety applications is entirely at the user's risk, and the user agrees to defend, indemnify and hold FTDI harmless from any and all damages, claims, suits or expense resulting from such use.

**Future Technology Devices International Limited (FTDI)** Unit 1, 2 Seaward Place, Glasgow G41 1HH, United Kingdom Tel.: +44 (0) 141 429 2777 Fax: + 44 (0) 141 429 2758 Web Site: <u>http://ftdichip.com</u> Copyright © Future Technology Devices International Limited



# **Table of Contents**

1 Introduction	4
1.1 Pre-requisite	4
2 User Interface	5
3 Chip Configuration: Common Configuration	on 7
3.1 Buffer Configuration	9
4 Advance configuration Settings	10
4.1 Camera Terminal Controls	15
4.2 Processing Unit Control	
4.3 Enabling UVC Controls	22
4.4 UVC Control in Video Capture applications	23
5 Auxiliary Interface	
5.1 Hiding Auxiliary interface	27
5.2 Re-enable Auxiliary interface	27
6 I <sup>2</sup> C Interface	28
6.1 Writing to a slave on the I <sup>2</sup> C bus	
6.2 Reading from a slave on the I <sup>2</sup> C Bus	
6.3 I <sup>2</sup> C Slave Device Registers	29
7 Contact Information	33
Appendix A – References	
Document References	
Acronyms and Abbreviations	
Appendix B – List of Tables & Figures	35
List of Tables	35
List of Figures	35
Appendix C – Revision History	





## **1** Introduction

This document explains how to use the FT602 Series Chip Configuration Programmer, a utility application for customizing the chip configuration.

### **1.1 Pre-requisite**

A PC running Windows 7 Operating System or later is required.

The PC should also be installed with the Microsoft Visual C++ 2013 Redistributable (x86) package. Follow the following steps to install it:-

- 1. Go to <a href="https://www.microsoft.com/en-us/download/details.aspx?id=40784">https://www.microsoft.com/en-us/download/details.aspx?id=40784</a>
- 2. Click 'Download' button
- 3. Check the **'vcredist\_x86.exe'** and click **'Next'**.
- 4. After download completes, run 'vcredist\_x86.exe' to install the package

Install FT602 WinUSB driver:

- 1. Run 'FT602WinUSBInstallation.exe'
- 2. Click 'Extract' button
- 3. Check License Agreement and click 'Next'
- 4. Click 'Finish' button when the driver installation is completed.



# 2 User Interface

Below is a screenshot of the FT602 Chip Configuration Programmer application.

FT602 Configuration Programmer	×
General Config FIFO Channel 1	
Device Descriptor Vendor ID 0x0403 Product ID 0x602A	Fifo Configuration FIFO Clock 100 MHz FIFO Mode 600 Mode
String Descriptor Manufacturer FTDI Description FTDI Superspeed Video Bridge	
Serial Number 000000000000000000000000000000000000	Auxiliary Interface
Configuration Descriptor Bus-powered  Self-powered	I2C Speed 1MHZ   I2C Address 0x0D
Max Power(SuperSpeed) (1unit = 8mA) 48 384mA Max Power(HS/FS) (1unit = 2mA) 12 24mA	Interrupt Enabled Interrupt bInterval 9
Save To File Read From File	Read Configuration Write Configuration Revision: 1.1.12



The application allows the user to write and read the device configuration.

Main Buttons	Description
Write Configuration	The fields from the UI will be selected as a new configuration and written to the device.
Read Configuration	Clicking this button will show the current settings that the device is configured with.



Save To File	This option allows the user to save the configuration to a file.
Read From File.	This option allows the user to read a configuration from a file and populate the UI fields. Later if the user wishes to write this to the device, a "write configuration" can be done.

### Table 1 - Main UI Controls Description

Channels pages of the FT602 Configuration Programmer application allow for setting buffer sizes and some advanced features.

FT602 Configuration Programmer	<b>×</b>
General Config Fifo Channel 1 Fifo Channel 2 Fifo Channel 3 Fifo Channel 4	
Channel Settings	
Channel Configuration	
Description FTDI Superspeed Video Channel 1	
Burst Buffer 4K	
Switch to Advanced Mode	
Read Configuratio	Write Configuration

### Figure 2 – Channels Page



# 3 Chip Configuration: Common Configuration

Controls		Default Value	Description
Vendor ID		0x0403	Vendor identification as specified in the idVendor field of the USB Device Descriptor
Product ID		0x602D	Product identification as specified in the idProduct field of the USB Device Descriptor Default is 0x602D for 4 channels. This will be
			changed automatically as and when the number of channels configured has been changed.
	Manufacturer	FTDI	Name of Manufacturer as specified in the USB Device Descriptor
	Product Description	FTDI SuperSpeed Video Bridge	Product name as specified in the USB Device Descriptor
Strings Serial Number		000000000001	Serial Number as specified in the USB Device Descriptor
	Channel Description	FTDI SuperSpeed Video Channel	Each channel is a function and each function can have its own string to differentiate it from the others. This option is available in the channels page of the application.
Bus-powered/Self- powered		Self-powered	Bus-powered or self-powered capability as specified in Bit 6 of the bmAttributes field of the USB Configuration Descriptor
Remote Wakeup		Disabled	Remote wakeup capability as specified in the bmAttributes field of the USB Configuration Descriptor
Max Power (SuperSpeed)		48 (384mA)	Maximum power consumption derived from the bMaxPower field of the USB Configuration Descriptor. This value is equivalent to bMaxPower/8 if USB 3.0 and bMaxPower/2 if USB 2.0.
Max Power (HS/FS)		12 (24mA)	Maximum power consumption derived from the bMaxPower field of the USB Configuration Descriptor. This value is equivalent to bMaxPower/8 if USB 3.0 and bMaxPower/2 if USB 2.0.
FIFO Clo	ock	100 MHz	Clock speed of the FIFO in MHz



#### Application Note AN\_435 FT602 UVC Chip Configuration Guide Version 1.2

Document Reference No.: FT\_001393 Clearance No.: FTDI#525

Controls	Default Value	Description
		Mode of the FIFO (245 mode or 600 mode)
FIFO Mode	600 Mode	Note that theFIFO mode selected should match the protocol used by the external FIFO master.
		Data transfer will not work if the FIFO protocol used does not match.
Channel Configuration 4 Channels		One channel is one UVC interface. When 4 channels are selected, there will be 4 UVC interfaces.
FIFO Buffer	4K (Per Channel)	Total size of the FIFO buffer is 16K. As 4 Channels are selected in default configuration the default FIFO buffer per channel is 4K.
		This option is available in the channels page.
Burst Buffer	4K (Per Channel)	Max Burst is 16K. Hence the default is 4K per channel as 4 channels are selected by default.
		This option is available in the channels page.
I <sup>2</sup> C Speed	1MHZ	Supports 1MHz, 400KHz and 100KHz. 1MHz is the default.
I <sup>2</sup> C Address	0x0D	I <sup>2</sup> C Slave address to which device sends the initialization parameters and UVC specific commands
Interrupt Enabled.	Set	Enables an interrupt. GPIO 2 is used for interrupt. This is active low. Host application running on Auxiliary interface will get a notification.
	9	Minimum latency is 2**(bInterval-1) USB frames.
Interrupt Latency (bInterval)		Default value of 9, will give a latency of 2**(9-1) USB frames. That is 256 frames. As 1 frame is 125us, this gives a latency of 32ms.
		bInterval can be modified to reduce or increase this latency. Minimum value is 1 and the max is 16.

### Table 2 – User Configurable Common Configuration - Description

**Note:** When calculating the maximum string length of a string descriptor the following rules must be applied:

Each string descriptor requires a 2 byte header therefore of the maximum 128 bytes there is 128-6=122 bytes available.

As the data is sent in Unicode, this then divides down to 122/2=61 bytes.



Additional restrictions are also applied:

Max size for SerialNumber is 16 characters

Max size for Description is 32 characters

Max size for Manufacturer is 61-32-16=13 characters when Description and SerialNumber are maxed out.

### 3.1 Buffer Configuration

Whenever there is a channel configuration change, or FIFO buffer or burst buffer selection change, another configuration pop up will be shown so that buffers for all the channels can be configured at once.

**Note:** Whenever there is a change in buffer size, the total buffer size must be 16K. Otherwise the tool won't let the user program the configuration changes.

The picture	below	shows a	a	configuration	for two	channels.

Channel 1 Burst Buffer	8K 🔻	Channel 1 FIFO Buffer	8K 🔻
Channel 2 Burst Buffer	8K 👻	Channel 2 FIFO Buffer	8K 🔹
Channel 3 Burst Buffer	DISABLE	Channel 3 FIFO Buffer	DISABLE 👻
Channel 4 Burst Buffer	DISABLE	Channel 4 FIFO Buffer	DISABLE 🔻
Total Size	16384	Total Size	16384
Cannot excee	ed 16384	Cannot exce	ed 16384

Figure 3 –Buffer Management



## 4 Advance configuration Settings

There are some advance settings available for expert users to configure the UVC terminal and processing controls.

FT602 C	Configu	ration F	Programmer					
Jeneral C	onfig	FIFO Ch	annel 1					
Cha	nnel Set	tings (	Controls Camera Set	ings Config Processin	g Unit conf	ìg		
	Camera /	/ Video /	Frame Controls					
	Cam T	erminal	Processing Lipit Vid	ao Standarde SS Fran	e Info 😐	S Frame Info	ES Era	ameInfo
	Call I	criticida	Processing onice viol	eo standarda		STRAILE INO	13114	aneino
		SN	Resolution(width)	Resolution(height)	Pixel Clo	ck F	PS	<u> </u>
		1	640	480	2700000	0 6	0	
		2	1280	720	7425000	0 6	0	Ξ.
		4	1920	1060	1405000		iU .	
		5						
		6						
		7						
		9						-
	Colo Tran: Matr	r Primari sfer Cha rix Coeff	es Unspecifi rracteristics Unspecifi icients Unspecifi	ed   ed  ed  ed  ed  ed  ed  ed  ed  ed	Bits Per Pix	<pre>(el 16 C_YUY2 ▼)</pre>		
								Read Configuration Write Configuration

Figure 4 – Advanced UVC Settings



#### Application Note AN\_435 FT602 UVC Chip Configuration Guide Version 1.2

Document Reference No.: FT\_001393 Clearance No.: FTDI#525

Controls	type	Description				
		Refer to the USB Video Class 1.1 specification, section <b>3.7.2.3 Camera Terminal Descriptor</b> for more details.				
		This bitmap is used to enable or disable certain controls for the camera.				
		When one of the read or write option is set, it indicates that the mentioned Control is supported for the video stream.				
		When the 'Read' option is set, then all the GET control commands mentioned in the section <b>4.2.2</b> of the specification is supported. Similarly when the 'Write' option is set, SET command is supported.				
Camera Terminal Controls	Bitmap	Following controls are available for user configuration.				
		<ul> <li>Auto-Exposure Mode</li> <li>Auto-Exposure Priority</li> <li>Exposure Time (Absolute)</li> <li>Exposure Time (Relative)</li> <li>Focus (Absolute)</li> <li>Focus (Relative)</li> <li>Iris (Absolute)</li> <li>Iris (Relative)</li> <li>Zoom (Absolute)</li> <li>Zoom (Relative)</li> <li>PanTilt (Absolute)</li> <li>Roll (Absolute)</li> <li>Roll (Relative)</li> <li>Focus, Auto</li> </ul>				
	Bitmap (bmControls)	Refer to the USB Video Class 1.1 specification, section 3.7.2.5 Processing Unit Descriptor for more details.				
		This indicates the availability of certain processing Controls for the video stream.				
Processing Unit		When any of the read or write option is set, it indicates that the mentioned Control is supported for the video stream.				
Controis		When the 'Read' option is set, then all the GET control commands mentioned in the section <b>4.2.2</b> of the specification is supported. Similarly when the 'Write' option is set, SET command is supported.				
		Following controls are available for user configuration.				
		<ul> <li>Brightness</li> <li>Contrast</li> </ul>				



Controls	type	Description			
		<ul> <li>Hue</li> <li>Saturation</li> <li>Sharpness</li> <li>Gamma</li> <li>White Balance Temperature</li> <li>White Balance Component</li> <li>Backlight Compensation</li> <li>Gain</li> <li>Power Line Frequency</li> <li>Hue, Auto</li> <li>White Balance Temperature, Auto</li> <li>White Balance Component, Auto</li> <li>Digital Multiplier</li> <li>Digital Multiplier Limit</li> <li>Analog Video Standard</li> </ul>			
		A bitmap of all analog video standards supported by the Processing Unit. A value of zero indicates that this bitmap should be			
	Pitman	ignored.			
	(bmVideoStandards)	• None			
		<ul> <li>NTSC - 525/60</li> <li>PAL - 625/50</li> <li>SECAM - 625/50</li> <li>NTSC - 625/50</li> <li>PAL - 525/60</li> </ul>			
	Resolution	Width * Height in pixels.			
	Frame Interval	This value indicates the number of frames per second. For example, for a 60fps, the value should be 60.			
		This defines the color primaries and the reference white.			
		Following options are available to choose.			
Frame Info		0: Unspecified (Image characteristics unknown)			
	Color Primarias	1: 61.709, SKGB (default)			
		2. BT.470-2 (F) 3: BT.470-2 (B. G)			
		4: SMPTE 170M			
		5: SMPTE 240M			
		Please refer to 3.9.2.6 Color Matching Descriptor of UVC specification 1.1.			



#### Application Note AN\_435 FT602 UVC Chip Configuration Guide Version 1.2

Document Reference No.: FT\_001393 Clearance No.: FTDI#525

Controls	type	Description
		This field defines the optoelectronic transfer characteristic of the source picture also called the gamma function.
		Following options are available for selection.
		0: Unspecified (Image characteristics unknown)
		1: BT.709 (default)
	Transfer	2: BT.470-2 M
	Characteristics	3: BT.470-2 B, G
		4: SMPTE 170M
		5: SMPTE 240M
		6: Linear (V = Lc)
		7: sRGB (very similar to BT.709)
		Refer to 3.9.2.6 Color Matching Descriptor of UVC specification 1.1.
		Matrix used to compute luma and chroma values from the color primaries.
		0: Unspecified (Image characteristics unknown)
		1: BT. 709
		2: FCC
	Matrix Coefficients	3: BT.470-2 B, G
		4: SMPTE 170M (BT.601, default)
		5: SMPTE 240M
		Refer to 3.9.2.6 Color Matching Descriptor of UVC specification 1.1.
		It's a sequence of 4 bytes used to uniquely identify data formats.
		Please visit <u>http://www.fourcc.org/</u> for more information.
	FCC (Four Character	Following option formats are available.
		<ul> <li>&gt; YUY2</li> <li>&gt; YUYV</li> </ul>
		• Y41P
		o YUVP o YUV4
		o IYU2
		<ul> <li>AYUV</li> <li>NV12</li> </ul>
		• NV16



#### Application Note AN\_435 FT602 UVC Chip Configuration Guide Version 1.2

Document Reference No.: FT\_001393 Clearance No.: FTDI#525

Controls	type	Description
		<ul> <li>NV24</li> <li>YV12</li> <li>GREY</li> <li>Y16</li> <li>RGBP</li> <li>RGB3</li> <li>RGB4</li> <li>BA24</li> <li>BY8</li> <li>BY8</li> <li>BYR2</li> </ul>
	Bits Per Pixel (Read only)	This is read only. And gets generated based on the FCC selected.

### Table 3 – Camera Terminal, Processing Unit & Frame Information



### **4.1 Camera Terminal Controls**

A separate tab named "*Camera Setting config*" is provided in the tool in the channels page .This allows the user to define the default values, steps (Resolution), min and max values of each control.

Refer to the section 4.2.2.1 Camera Terminal Control Requests of UVC specification 1.1.

hannel Settings Controls	Camera S	ettings Config	Processing U	nit config				
Exposure Time (Absoulte)	Default		Steps	1	Min	1	Max	4294967295
Focus (Absolute)	Default	1	Steps	1	Min	0	Max	65535
Iris (Absolute)	Default	1	Steps	1	Min	1	Max	128
Objective Focal Length	Default	0	Steps	1	Min	0	Max	32767
Pan (Absolute)	Default	0	Steps	1	Min	-2147483648	Max	2147483647
Tilt (Absolute)	Default	0	Steps	1	Min	-2147483648	Max	2147483647
Roll (Absolute)	Default	0	Steps	0	Min	0	Max	0
						Read Co	nfigurati	on Write Configurat

Figure 5 – Camera Terminal Configurable Options



The table below shows each configurable control where the user is allowed to define the values.

Controls	Description
	Refer to Section 4.2.2.1.4 Exposure Time (Absolute) Control of UVC 1.1 for more information.
Exposure Time (Absolute)	The Exposure Time (Absolute) Control is used to specify the length of exposure. This value is expressed in 100µs units, where 1 is 1/10,000th of a second, 10,000 is 1 second, and 100,000 are 10 seconds. A value of zero (0) is undefined. Note that the manual exposure control is further limited by the frame interval, which always has higher precedence. If the frame interval is changed to a value below the current value of the Exposure Control, the Exposure Control value will automatically be changed. The default Exposure Control value will be the current frame interval until an explicit exposure value is chosen
	The setting for the attribute of the addressed Exposure Time (Absolute) Control:
	0: Reserved
	1: 0.0001 sec
	100000: 10 sec
	Refer to section 4.2.2.1.6 Focus (Absolute) Control of UVC 1.1 for more information.
Focus (Absolute)	The Focus (Absolute) Control is used to specify the distance to the optimally focused target. This value is expressed in millimeters. The default value is implementation-specific.
Iris (Absolute)	Refer to section 4.2.2.1.9 Iris (Absolute) Control of UVC 1.1 The Iris (Absolute) Control is used to specify the camera's aperture setting. This value is expressed in units of $f_{stop}^*$ 100. The default value is implementation-specific.
Objective Focal Length / Zoom (Absolute)	Refer to the section 4.2.2.1.11 Zoom (Absolute) Control of UVC 1.1 The Zoom (Absolute) Control is used to specify or determine the Objective lens focal length. This control is used in combination with the wObjectiveFocalLengthMin and wObjectiveFocalLengthMax fields in the Camera Terminal descriptor to describe and control the Objective lens focal length of the device (see section 2.4.2.5.1 "Optical Zoom").The MIN and MAX values are sufficient to imply the resolution, so the RES(steps) value must always be 1. The MIN, MAX and default values are implementation dependent.



Controls	Description
Pan (Absolute)	Refer to section 4.2.2.1.13 PanTilt (Absolute) Control of UVC 1.1 The dwPanAbsolute is used to specify the pan setting in arc second units. 1 arc second is 1/3600 of a degree. Values range from – 180*3600 arc second to +180*3600 arc second, or a subset thereof, with the default set to zero. Positive values are clockwise from the origin (the camera rotates clockwise when viewed from above), and negative values are counterclockwise from the origin.
Tilt (Absolute)	Refer to section 4.2.2.1.13 PanTilt (Absolute) Control of UVC 1.1 for more information. The dwTiltAbsolute Control is used to specify the tilt setting in arc second units. 1 arc second is 1/3600 of a degree. Values range from -180*3600 arc second to +180*3600 arc second, or a subset thereof, with the default set to zero. Positive values point the imaging plane up, and negative values point the imaging plane down
Roll (Absolute)	Refer to section 4.2.2.1.15 Roll (Absolute) Control of UVC 1.1 for more information. The Roll (Absolute) Control is used to specify the roll setting in degrees. Values range from – 180 to +180, or a subset thereof, with the default being set to zero. Positive values cause a clockwise rotation of the camera along the image viewing axis, and negative values cause a counterclockwise rotation of the camera.

**Table 4 – Camera Terminal Control Options** 



### 4.2 **Processing Unit Control**

A separate tab named "*Processing Unit config*" is provided in the tool in the channels page. This allows the user to define the default values, steps (Resolution), min and max values of each control.

Refer to section 4.2.2.3 Processing Unit Control Requests of the UVC specification 1.1.

FT602 Configuration Program	mer						×
General Config Fifo Channel 1	Fifo Channel 2 Fifo Char	nnel 3 Fifo Ch	annel 4				
	_						
Channel Settings   Controls	Camera Settings Config	Processing Ur					- II
Backlight Compensation	Default 🧕	Steps	0	Min	0	Max 0	
Brightness	Default 0	Steps	1	Min	-32768	Max 32767	
Contrast	Default 0	Steps	1	Min	0	Max 32767	
Gain	Default 0	Steps	1	Min	0	Max 32767	
Hue	Default 0	Steps	0	Min	0	Max 0	
Saturation	Default 0	Steps	1	Min	0	Max 32767	
Sharpness	Default 0	Steps	1	Min	0	Max 32767	
Gamma	Default 1	Steps	1	Min	1	Max 500	
White Balance Temperature	e Default 0	Steps	1	Min	0	Max 32767	
White Balance Blue	Default 0	Steps	1	Min	0	Max 32767	
White Balance Red	Default 0	Steps	1	Min	0	Max 32767	
Multiplier Step	Default 0	Steps	1	Min	0	Max 32767	
Multiplier Limit	Default 0	Steps	1	Min	0	Max 32767	
Power Line Fre	DISABLED	•					
					Read Con	nfiguration Write Configurat	ion
L							

### Figure 6 – Processing Unit Control Options

The following table presents a detailed description of all possible Controls a Processing Unit can incorporate. For each Control, the layout of the parameter block together with the appropriate Control Selector is listed for all forms of the Get/Set Processing Unit Control request. All values are interpreted as unsigned unless otherwise specified.



Controls	Description
Backlight compensation	Refer to section 4.2.2.3.1 Backlight Compensation Control of the UVC spec 1.1 for more information. The Backlight Compensation Control is used to specify the backlight compensation. A value of zero indicates that the backlight compensation is disabled. A non-zero value indicates that the backlight compensation is enabled. The device may support a range of values, or simply a binary switch. If a range is supported, a low number indicates the least amount of backlight compensation. The default value is implementation-specific, but enabling backlight compensation is recommended.
Brightness	Refer to section 4.2.2.3.2 Brightness Control of the UVC spec 1.1 for more information.
Drighthess	increasing values indicate increasing brightness. This is a relative value where increasing values indicate increasing brightness. The MIN and MAX values are sufficient to imply the resolution, so the RES value must always be 1. The MIN, MAX and default values are implementation dependent.
	Refer to section 4.2.2.3.3 Contrast Control of the UVC spec 1.1 for more information.
Contrast	This is used to specify the contrast value. This is a relative value where increasing values indicate increasing contrast. The MIN and MAX values are sufficient to imply the resolution, so the RES value must always be 1. The MIN, MAX and default values are implementation dependent.
	Refer to section 4.2.2.3.4 Gain Control of the UVC spec 1.1 for more information.
Gain	This is used to specify the gain setting. This is a relative value where increasing values indicate increasing gain. The MIN and MAX values are sufficient to imply the resolution, so the RES value must always be 1. The MIN, MAX and default values are implementation dependent.
	Refer to section 4.2.2.3.6 Hue Control of the UVC spec 1.1 for more information.
Hue	This is used to specify the hue setting. The value of the hue setting is expressed in degrees multiplied by 100. The required range must be a subset of $-18000$ to $18000$ ( $-180$ to $+180$ degrees). The default value must be zero.
	Refer to section 4.2.2.3.8 Saturation Control of the UVC spec 1.1 for more information.
Saturation	This is used to specify the saturation setting. This is a relative value where increasing values indicate increasing saturation. A Saturation value of 0 indicates grayscale. The MIN and MAX values are



Controls	Description
	sufficient to imply the resolution, so the RES value must always be 1.
	The MIN, MAX and default values are implementation-dependent
	Refer to section 4.2.2.3.9 Sharpness Control of the UVC spec 1.1 for more information.
Sharpness	This is used to specify the sharpness setting. This is a relative value where increasing values indicate increasing sharpness, and the MIN value always implies "no sharpness processing", where the device will not process the video image to sharpen edges. The MIN and MAX values are sufficient to imply the resolution, so the RES value must always be 1. The MIN, MAX and default values are implementation-dependent
	Refer to section 4.2.2.3.10 Gamma Control of the UVC spec 1.1 for more information.
Gamma	This is used to specify the gamma setting. The value of the gamma setting is expressed in gamma multiplied by 100. The required range must be a subset of 1 to 500, and the default values are typically 100 (gamma = 1) or 220 (gamma = 2.2).
	Refer to the section 4.2.2.3.11 White Balance Temperature Control of the UVC spec 1.1 for more information.
White Balance Temperature	This is used to specify the white balance setting as a color temperature in degrees Kelvin. This is offered as an alternative to the White Balance Component control. Minimum range should be 2800 (incandescent) to 6500 (daylight) for webcams and dual-mode cameras. The supported range and default value for white balance temperature is implementation-dependent.
	Refer to section 4.2.2.3.13 White Balance Component Control of the UVC spec 1.1 for more information.
White Balance Blue	The setting for the blue component of the addressed White Balance Component control.
White Balance Red	Refer to section 4.2.2.3.13 White Balance Component Control of the UVC spec 1.1 for more information.
	The setting for the red component of the addressed White Balance Component control.



Controls	Description
	Refer to section 4.2.2.3.15 Digital Multiplier Control of the UVC spec 1.1 for more information.
Digital Multiplier Step	This is used to specify the amount of Digital Zoom applied to the optical image. This is the position within the range of possible values of multiplier m, allowing the multiplier resolution to be described by the device implementation. The MIN and MAX values are sufficient to imply the resolution, so the RES value must always be 1. The MIN, MAX and default values are implementation dependent. If the Digital Multiplier Limit Control is supported, the MIN and MAX values shall match the MIN and MAX values of the Digital Multiplier Control.
	Refer to section 4.2.2.3.16 Digital Multiplier Limit Control of the UVC spec 1.1 for more information.
Digital Multiplier Limit	This is used to specify an upper limit for the amount of Digital Zoom applied to the optical image. This is the maximum position within the range of possible values of multiplier m. The MIN and MAX values are sufficient to imply the resolution, so the RES value must always be 1. The MIN, MAX and default values are implementation dependent.
	A value specifying the upper bound for Z'cur (see section 2.4.2.5.2 "Digital Zoom" of UVC spec 1.1.)
	Refer to the section 4.2.2.3.5 Power Line Frequency Control of the UVC spec 1.1 for more information.
Power Line Frequency	This control allows the host software to specify the local power line frequency, in order for the device to properly implement anti-flicker processing, if supported. The default is implementation-specific.
	The setting for the attribute of the addressed Power Line Frequency control:
	0: Disabled
	1: 50 Hz
	2: 60 Hz

### Table 5 – Processing Control & Description



### 4.3 Enabling UVC Controls

The camera and processing unit controls which were discussed above, are by default disabled. To get or set a value for a control using video capture applications such as amCap, read and write options for that control shall first be enabled.

An example picture is as shown below. Read and write options have to be selected (tick-ed) to enable the corresponding control.

				a version and		
hannel Settings	Controls Camera S	iettings Ca	nfig Processing Unit o	onfig		
3 MM 3	20 B B B					
Camera / video /	Frame Controls		entral languages and	in a second s		
Cam Terminal	Processing Unit	video Stani	dards   SS Prame Info	HS Frane Info   FS FraneInfo	201211	Sector 2
Brightness		Read	Write	Contrast	Read	Write E
Hue		•		Saturation	0	8
Sharpness		11	10	Gamma	11	8
White Balan	ce Temperature	10	<b></b>	White Balance Component	四	23
Backlight Co	mpensation	83	10	Gain	81	
Power Line I	requencey	12	10	Hue (Auto)	10	123
White Balan	ce Temperatur (Au	to) 🗐	E3	White Balance Component (Auto)	85	10
Digital Multip	der .	曰	10	Digital Multiplier Limit	司	回
Analog Vide	o Standard	10	10 I			
-						
				-		

Figure 7 Processing Unit Control



### 4.4 UVC Control in Video Capture applications

Once the read and write permissions are set in the configuration, video capture applications can change the values of these controls. A sample picture from amCap application is shown below.

Properties						<b></b> >	×]	
Video Proc Amp	Camera (	Control						
E	rightness	<u></u>	0		2184	Auto		
	Contrast	0						
	aturation iharoness	0						
White	Gamma e Balance	0						
Backl	ght Comp	0						
	Gain ColorEnab	ie 🗌	PowerLine	Frequency (Anti Flicker)		<u> </u>		
-		(	Default	]				
			ОК	Cance	el 🛛	Apply		

Figure 8 Application adjusting a UVC control



# **5** Auxiliary Interface

The FT602 Chip Configuration Programmer application uses the auxiliary interface to communicate with the device. There is an auxiliary interface in addition to the UVC interface, as seen in the picture below.



Figure 9 Auxiliary interface highlighted

When this auxiliary interface is enumerated, in most of the cases, Windows is able to successfully install the WinUSB drivers. However, depending on certain versions of the Windows operating system, drivers for this interface may not load or install successfully. In such cases, configuration programmer cannot run as it fails to identify the interface and WinUSB installation has to be performed manually

Follow the below steps to install WinUSB driver.

- 1. Double click FT602WinUSBInstallation.exe.
- 2. Click on the 'extract' button to unpack the installer.





Figure 10 WinUSB Setup Procedure

3. Click Next.



Figure 11 WinUSB Setup Procedure



4. Select 'I accept this agreement' and click Next.

icense A	jreement
Ń	To continue, accept the following license agreement. To read the entire agreement, use the scroll bar or press the Page Down key.
	IMPORTANT NOTICE: PLEASE READ CAREFULLY BEFORE INSTALLING THE RELEVANT SOFTWARE: This licence agreement (Licence) is a legal agreement between you (Licensee or you) and Future Technology Devices International Limited of 2 Seaward Place, Certurion Business Park, Glasgow G41 1HH, Scotland (UK Company Number SC136640) (Licensor or we) for use of driver software provided by the Licensor(Software). BY INSTALLING OR USING THIS SOFTWARE YOU AGREE TO THE $\checkmark$
	I accept this agreement     Save As     Print
	I don't accept this agreement

Figure 12 WinUSB Setup Procedure

5. Click on Finish button. Installation is completed.



Figure 13 WinUSB Setup Procedure



### **5.1 Hiding Auxiliary interface**

When the product is ready to be deployed, the auxiliary interface may be removed. This shortens the time taken to install device drivers in the system and removes the reliance on WinUSB driver in end user systems.

Using the Configuration Programmer, uncheck the auxiliary interface check box and click the write configuration button. This will re-enumerate the device without auxiliary interface.

General Config       FEO Channel 1         Device Descriptor       0x0403         Yendor ID       0x602A         String Descriptor       FIFO Clock         Manufacturer       FIDI         Descriptor       FIFO Mode         Manufacturer       FIDI         Descriptor       Channel Config 1 Channel •         Max Forwer (SuperSpeed) (Junit = 8mA)       43         Max Power (HS/FS) (Junit = 2mA)       12         Yenzet ID       12         Save To FIE       Red From FIE	FT602 Configuration Programmer	
Device Descriptor   Vendor ID   Vendor ID   Vendor ID   Vendor ID   Vendor ID   String Descriptor   Manufacturer   TDI   Descriptor   TDI Superspeed Video Bridge   Serial Number   00000000001   Bus-powered   Image: Descriptor   Bus-powered   Image: Descriptor   Image: Descriptor	General Config FIFO Channel 1	
String Descriptor         Manufacturer         Descripton         FDI Superspeed Video Bridge         Serial Number         Configuration Descriptor         Bus-powered         Bus-powered         Bus-powered         Bus-powered         Interrupt Enabled         Interrupt bInterval         Interrupt bInterval	Device Descriptor Vendor ID 0x0403 Product ID 0x602A	FIFO Clock 100 MHz  FIFO Clock 600 Mode
Description       F1DI Superspeed Video Bridge         Serial Number       00000000001         Configuration Descriptor       Image: Configuration Descriptor         Bus-powered       Self-powered         Max Power(SuperSpeed) (1unit = 8mA)       48         Max Power(HS/FS) (1unit = 2mA)       12         2 dmA       Interrupt Enabled         Interrupt bInterval       Interrupt bInterval	String Descriptor Manufacturer FTDI	Channel Config 1 Channel
Configuration Descriptor       I2C Speed       IMHZ         Bus-powered       I2C Address       Dx0D         Max Power(SuperSpeed) (1unit = 8mA)       48       384mA       Interrupt Enabled         Max Power(HS/FS) (1unit = 2mA)       12       24mA       Interrupt binterval         Save To File       Read From File       Read Configuration       Write Configuration	Description FTDI Superspeed Video Bridge Serial Number 00000000001	Auxiliary Interface
Max Power(SuperSpeed) (1unit = 8mA)       48       384mA         Max Power(HS/FS) (1unit = 2mA)       12       24mA         Interrupt bInterval       0         Save To File       Read From File         Read Configuration       Write Configuration	Configuration Descriptor  Bus-powered  Self-powered	I2C Speed IMHZ   I2C Address
Save To File     Read From File       Write Configuration     Write Configuration	Max Power(SuperSpeed) (1unit = 8mA) 48 384mA Max Power(HS/FS) (1unit = 2mA) 12 24mA	Interrupt Enabled
Save To File     Read From File       Write Configuration     Write Configuration		
Save To File         Read From File         Write Configuration		
Revision: 1.1.12	Save To File Read From File	Read Configuration Write Configuration Revision: 1.1.12

#### Figure 14 Disable Auxiliary Interface

### 5.2 Re-enable Auxiliary interface

To bring back the auxiliary interface, check the auxiliary interface box in the configuration programmer. This will re-enable the interface and populate the fields in the UI. Write the configuration to save the settings permanently.

Disabling and enabling auxiliary interface may reset  $I^2C$  related configuration hence the  $I^2C$  related fields such as speed, address, and bInterval need to be re-programmed.



# **6** I<sup>2</sup>C Interface

The FT602 provides an I<sup>2</sup>C bus which operates as master with a default transmission speed of 1Mb/s. This speed is configurable and may be chosen from amongst 100Kb/s, 400Kb/s and 1Mb/s through the configuration programmer

When using video capture applications, when any of the UVC control value is changed, a UVC control message is sent to the UVC device. The device, in turn, relays the message to the FPGA using the I<sup>2</sup>C Interface. The I<sup>2</sup>C slave address to be used for this communication is set via the Configuration Programmer. The I<sup>2</sup>C slave (e.g. FPGA or FIFO Master) shall implement the registers described in the next sections.

### 6.1 Writing to a slave on the $I^2C$ bus.

To write on the  $I^2C$  bus, the master will send a start condition on the bus with the slave's address as well as the R/W bit set to 0 which signifies a write. After slave responds with an acknowledgement, the master will then send the register address it wishes to write to and the slave acknowledges again. After this, the master shall send the data to the slave and at end of data, the master shall terminate the transmission with a stop condition.



Figure 15 Example I<sup>2</sup>C write to slave's register.

## 6.2 Reading from a slave on the I<sup>2</sup>C Bus

To read from a slave, the master starts with an instruction to the slave which register it wishes to read from. This is done by sending the address with the R/W bit set to 0 (indicates a write), followed by the register address it wishes to read from. Once the slave acknowledges this register address, the master will send a START condition again followed by the slave address with R/W bit set to 1 (indicates read). The master will continue sending out the clock pulses so that the slave can transmit data.







## **6.3** I<sup>2</sup>C Slave Device Registers

The  $I^2C$  master currently supports registers listed in the below table. These are optional registers. The slave need not implement all of them. It can selectively implement the ones it wants to support.

			Size	
Register address	Name	Access	(Byte)	Description
				bit[7:4]: reserved
				bit[3]: I <sup>2</sup> C interrupt, 0 = disable, 1 = enable
				bit[2:1]:
				2′b00 = unknown speed
				2'b01 = Super Speed
				2′b10 = High Speed
				2'b11 = Full Speed
				B[0]: FIFO Mode, 0 = FT245, 1 = FT600
0x0	FT602 configuration(device reset)	W	1	
				0 = Wakeup,
				1 = Suspend,
				2 = PowerOff, (Host PC state)
0x1	FT602 power status	W	1	Others = Reserved
0x40 ~ 0x5F	UVC channel 1 controls	RW	-	Camera and Processing Unit Controls (as per UVC spec)
				Byte [8]: 0 based resolution index.
				Byte [7:4]: Clock Frequency in Hz.
				Byte [3:2]: Height
				Byte [1:0]: Width
0x60	Channel 1 start streaming	W	9	



1	1	1	1	1
0x70 ~ 0x8F	UVC channel 2 controls	RW	-	Camera and Processing Unit Controls (as per UVC spec)
				Byte [8]: 0 based resolution index.
				Byte [7:4]: Clock Frequency in Hz.
				Byte [3:2]: Height
				Byte [1:0]: Width
0x90	Channel 2 start streaming	W	9	
0xA0 ~ 0xBF	UVC channel 3 controls	RW	-	Camera and Processing Unit Controls (as per UVC spec)
				Byte [8]: 0 based resolution index.
				Byte [7:4]: Clock Frequency in Hz.
				Byte [3:2]: Height
				Byte [1:0]: Width
0xC0	Channel 3 start streaming	W	9	
0xD0 ~ 0xEF	UVC channel 4 controls	RW	-	Camera and Processing Unit Controls ( as per UVC spec)
				Byte [8]: 0 based resolution index.
				Byte [7:4]: Clock Frequency in Hz.
				Byte [3:2]: Height
				Byte [1:0]: Width
0xF0	Channel 4 selected frame info	w	9	

 Table 6 I<sup>2</sup>C Slave Registers



UVC Control Register Address		Register Name	Description		
Channel 1	Channel 2	Channel 3	Channel 4		
40	70	A0	D0	REG_CT_AE_MODE	Auto Exposure Mode
41	71	A1	D1	REG_CT_AE_PRIORITY	Auto Exposure Priority
42	72	A2	D2	REG_CT_EXPOSURE_TIME_ABSO LUTE	Exposure Time Absolute
43	73	A3	D3	REG_CT_EXPOSURE_TIME_RELA TIVE	Exposure Time Relative
44	74	A4	D4	REG_CT_FOCUS_ABSOLUTE	Focus Absolute
45	75	A5	D5	REG_CT_FOCUS_RELATIVE	Focus Relative
46	76	A6	D6	REG_CT_FOCUS_AUTO	Focus, Auto.
47	77	A7	D7	REG_CT_IRIS_ABSOLUTE	IRIS Absolute
48	78	A8	D8	REG_CT_IRIS_RELATIVE	IRIS Relative.
49	79	A9	D9	REG_CT_ZOOM_ABSOLUTE	Zoom Absolute
4A	7A	AA	DA	REG_CT_ZOOM_RELATIVE	Zoom Relative
4B	7B	AB	DB	REG_CT_PANTILT_ABSOLUTE	Pan-tilt Absolute
4C	7C	AC	DC	REG_CT_PANTILT_RELATIVE	Pan-tilt Relative
4D	7D	AD	DD	REG_CT_ROLL_ABSOLUTE	Roll Absolute
4E	7E	AE	DE	REG_CT_ROLL_RELATIVE	Roll Relative
4F	7F	AF	DF	REG_PU_BACKLIGHT_COMPENSA TION	Backlight Compensatio n
50	80	В0	E0	REG_PU_BRIGHTNESS	Brightness
51	81	B1	E1	REG_PU_CONTRAST	Contrast
52	82	B2	E2	REG_PU_GAIN	Gain
53	83	B3	E3	REG_PU_POWER_LINE_FREQUEN CY	Power line frequency
54	84	B4	E4	REG_PU_HUE	Hue
55	85	B5	E5	REG_PU_SATURATION	Saturation



#### Application Note AN\_435 FT602 UVC Chip Configuration Guide Version 1.2

Document Reference No.: FT\_001393 Clearance No.: FTDI#525

56	86	B6	E6	REG_PU_SHARPNESS	Sharpness
57	87	B7	E7	REG_PU_GAMMA	Gamma
58	88	B8	E8	REG_PU_WHITE_BALANCE_TEMP ERATURE	White Balance Temp.
59	89	В9	E9	REG_PU_WHITE_BALANCE_TEMP ERATURE_AUTO	White Balance Auto.
5A	8A	BA	EA	REG_PU_WHITE_BALANCE_COM PONENT	White Balance Component.
5B	8B	BB	ЕВ	REG_PU_WHITE_BALANCE_COM PONENT_AUTO	White Balance Component Auto.
5C	8C	BC	EC	REG_PU_DIGITAL_MULTIPLIER	Digital Multiplier
5D	8D	BD	ED	REG_PU_DIGITAL_MULTIPLIER_L IMIT	Digital Multiplier Limit
5E	8E	BE	EE	REG_PU_HUE_AUTO	Hue Auto.
5F	8F	BF	EF	REG_PU_ANALOG_VIDEO_STAN DARD	Analog Video Standard.

Table 7 UVC Registers



### 7 Contact Information

#### Head Office – Glasgow, UK

Future Technology Devices International Limited Unit 1, 2 Seaward Place, Centurion Business Park Glasgow G41 1HH United Kingdom Tel: +44 (0) 141 429 2777 Fax: +44 (0) 141 429 2758

E-mail (Sales)sales1@ftdichip.comE-mail (Support)support1@ftdichip.comE-mail (General Enquiries)admin1@ftdichip.com

#### Branch Office – Taipei, Taiwan

Future Technology Devices International Limited (Taiwan) 2F, No. 516, Sec. 1, NeiHu Road Taipei 114 Taiwan , R.O.C. Tel: +886 (0) 2 8797 1330 Fax: +886 (0) 2 8751 9737

E-mail (Sales) E-mail (Support) E-mail (General Enquiries)

tw.sales1@ftdichip.com tw.support1@ftdichip.com tw.admin1@ftdichip.com

#### Branch Office - Tigard, Oregon, USA

Future Technology Devices International Limited (USA) 7130 SW Fir Loop Tigard, OR 97223-8160 USA Tel: +1 (503) 547 0988 Fax: +1 (503) 547 0987

E-Mail (Sales) E-Mail (Support) E-Mail (General Enquiries) us.sales@ftdichip.com us.support@ftdichip.com us.admin@ftdichip.com

#### Branch Office - Shanghai, China

Future Technology Devices International Limited (China) Room 1103, No. 666 West Huaihai Road, Shanghai, 200052 China Tel: +86 21 62351596 Fax: +86 21 62351595

E-mail (Sales) E-mail (Support) E-mail (General Enquiries) cn.sales@ftdichip.com cn.support@ftdichip.com cn.admin@ftdichip.com

33

#### Web Site

http://ftdichip.com

#### **Distributor and Sales Representatives**

Please visit the Sales Network page of the <u>FTDI Web site</u> for the contact details of our distributor(s) and sales representative(s) in your country.

System and equipment manufacturers and designers are responsible to ensure that their systems, and any Future Technology Devices International Ltd (FTDI) devices incorporated in their systems, meet all applicable safety, regulatory and system-level performance requirements. All application-related information in this document (including application descriptions, suggested FTDI devices and other materials) is provided for reference only. While FTDI has taken care to assure it is accurate, this assistance provided by FTDI. Use of FTDI devices in life support and/or safety applications is entirely at the user's risk, and the user agrees to defend, indemnify and hold harmless FTDI from any and all damages, claims, suits or expense resulting from such use. This document is subject to change without notice. No freedom to use patents or other intellectual property rights is implied by the publication of this document. Neither the whole nor any part of the information contained in, or the product described in this document, may be adapted or reproduced in any material or electronic form without the prior written consent of the copyright holder. Future Technology Devices International Ltd, Unit 1, 2 Seaward Place, Centurion Business Park, Glasgow G41 1HH, United Kingdom. Scotland Registered Company Number: SC136640



# **Appendix A – References**

### **Document References**

USB Video Class 1.1.pdf FT602 USB 3.0 SuperSpeed UVC bridge IC datasheet UMFT602X development module datasheet https://www.fourcc.org/fourcc.php

### **Acronyms and Abbreviations**

Terms	Description
FIFO	First In First Out
ID	Identification
UI	User Interface
USB	Universal Serial Bus
UVC	USB Video Class.
VID	Vendor Identification
I <sup>2</sup> C	Inter-Integrated Circuit



# Appendix B – List of Tables & Figures

### **List of Tables**

Table 1 - Main UI Controls Description	6
Table 2 – User Configurable Common Configuration - Description	8
Table 3 – Camera Terminal, Processing Unit & Frame Information	. 14
Table 4 – Camera Terminal Control Options	. 17
Table 5 - Processing Control & Description	. 21
Table 6 I <sup>2</sup> C Slave Registers	. 30
Table 7 UVC Registers	. 32

## **List of Figures**

Figure 1 - Application Screenshot5
Figure 2 – Channels Page6
Figure 3 –Buffer Management
Figure 4 –Advanced UVC Settings 10
Figure 5 –Camera Terminal Configurable Options 15
Figure 6 –Processing Unit Control Options
Figure 7 Processing Unit Control 22
Figure 8 Application adjusting a UVC control
Figure 9 Auxiliary interface highlighted 24
Figure 10 WinUSB Setup Procedure 25
Figure 11 WinUSB Setup Procedure 25
Figure 12 WinUSB Setup Procedure
Figure 13 WinUSB Setup Procedure
Figure 14 Disable Auxiliary Interface 27
Figure 15 Example I <sup>2</sup> C write to slave's register
Figure 16 Example I <sup>2</sup> C Read from slave register



# **Appendix C – Revision History**

Document Title:	AN_435_FT602 UVC Chip Configuration Guide
Document Reference No.:	FT_001393
Clearance No.:	FTDI#525
Product Page:	http://www.ftdichip.com/FTProducts.htm
Document Feedback:	Send Feedback

Revision	Changes	Date
1.0	Initial Release	2017-03-23
1.1	Updated Section 1.1 Pre-requisite (WINUSB driver pre-installation descriptions added)	2017-04-18
1.2	Added the following section/information – Auxiliary Interface section WinUSB Setup Procedure. I <sup>2</sup> C related information I <sup>2</sup> C register related tables. Updated the screenshots with new UI	2017-12-08