AVerMedia

4K HDMI Signal Detector

CT130

English

User Manual

Disclaimer

All the screenshots in this documentation are only example images**.** The images may vary depending on the product and software version. Information presented in this documentation has been carefully checked for reliability; however, no responsibility is assumed for inaccuracies. The information contained in this documentation is subject to change without notice.

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⚠️ Important Safety Instructions

1. Read these instructions.

2. Keep these instructions.

3. Follow all instructions.

4. Heed all warnings.

5. Do not use the apparatus on uneven or unstable surfaces.

6. Do not use this apparatus in a wet environment or near water.

7. Unplug the apparatus before cleaning. Clean only with a dry cloth.

8. Use in a well ventilated environment. Do not block any ventilation openings.

9. Use the apparatus within ambient temperatures 32–122°F (0–50°C).

10. Use power sources within the specified voltage range.

11. Do not place heavy objects on the apparatus.

12. Do not install near heat sources such as radiators or stoves.

13. Do not defeat the safety purposes of the polarized or grounding-type plug.

14. Protect the power cord from being walked on or pinched, particularly where the cord connects with plugs or adapters.

15. Only use the attachments and accessories specified by the manufacturer.

16. Unplug this apparatus during lightning storms or when unused for prolonged periods of time.

17. Do not modify or disassemble the apparatus in any way.

18. Refer all servicing to qualified personnel.

19. Do not dispose the apparatus as general household waste. Dispose in accordance with local environmental laws.

Table of Contents

1. Introduction

The AVerMedia 4K HDMI Signal Detector CT130 is designed to check and report DC voltage level of each HDMI signal pin and quickly tests the continuity of all HDMI features.

This tester connects a source and a display to verify whether all digital signals are being transmitted properly, and it also ensures that the source HDMI signals are compliant with the specifications.

Two modes are used to check the signals, first mode is TMDS signal only with automatic detection, second mode is all the HDMI signals and sending voltage values to a dedicated PC program.

2. Package Contents

1. 4K HDMI Signal Detector CT130
2. USB Cable

3. Features

1. Support HDMI 2.0b display up to 4Kp60.
2. Low power consumption
3. 4 layers PCB with good EMI/EMC capability
4. ROHS compliant

4. Connections and Parts
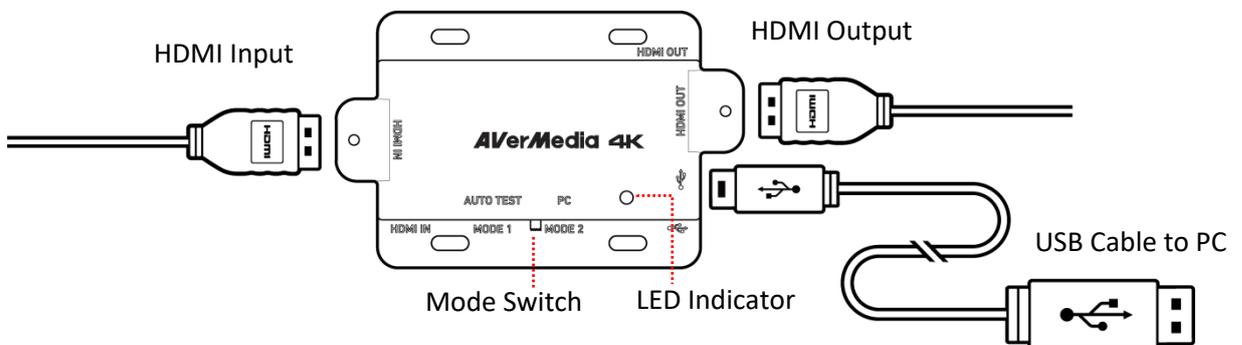
Order of Plugging In
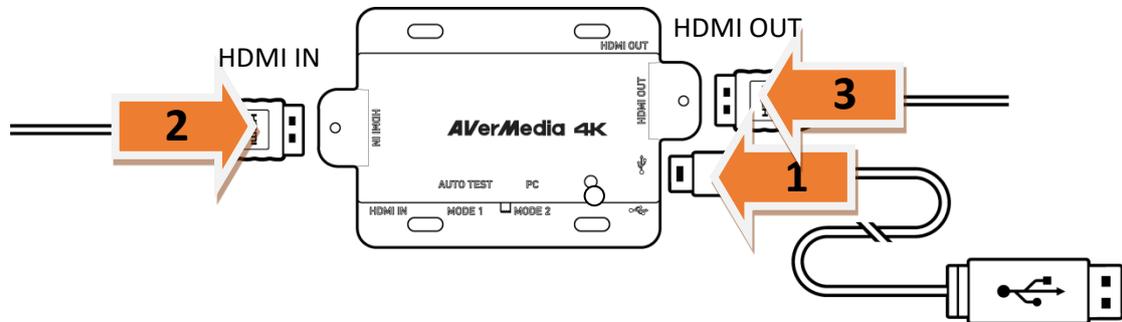
Step 1: Plug into the mini USB port

Step 2: Plug into the HDMI IN port

Step 3: Plug into the HDMI OUT port

Order of Unplugging
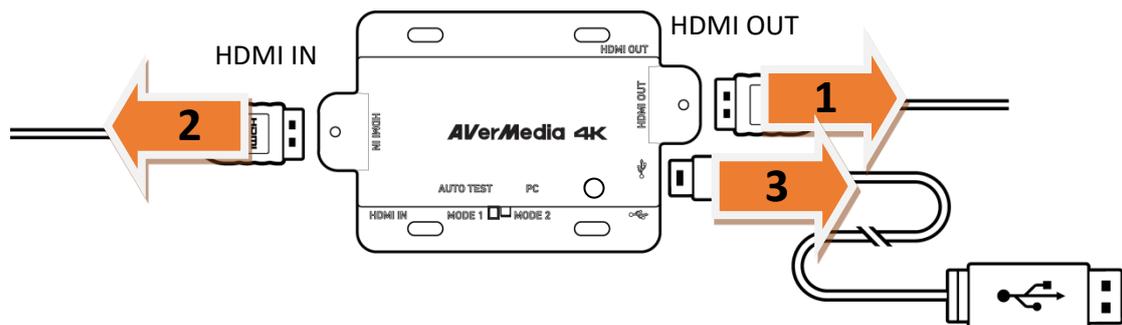
Step 1: Unplug from the HDMI OUT port

Step 2: Unplug from the HDMI IN port

Step 3: Unplug from the mini USB port

5. Test Setup and Requirements
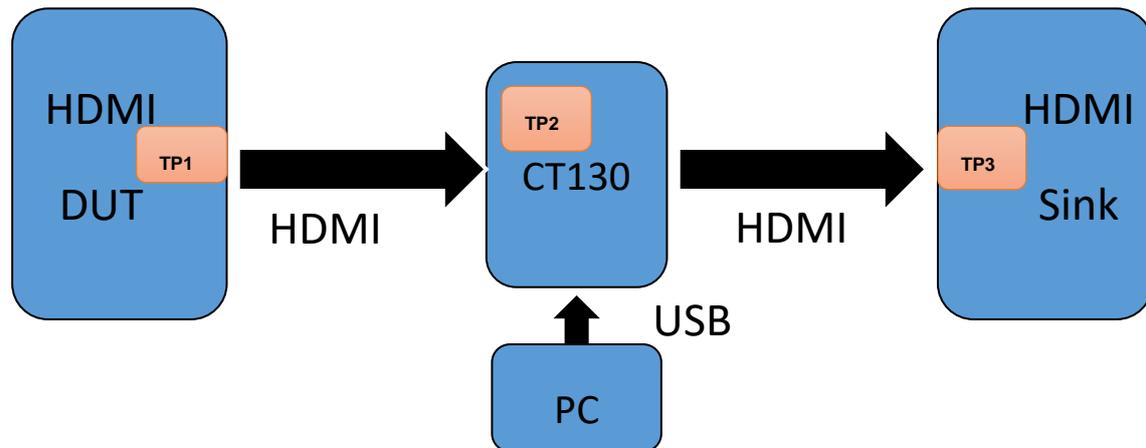
Pattern resolution: 1920*1080 p60

● HDMI cables are 10 meters and 1 meter respectively for HDMI source and sink devices

Pattern resolution: 3840*2160 p60

● HDMI cables are 3 meters and 1 meter respectively for HDMI source and sink devices (use HDMI Cable which passes HDMI 2.0 Premium Logo).

● Maximum USB cable length is 3 meters

6. Specifications

Board Dimensions

PCB Size	71 mm * 32 mm
Thickness	1.6 mm +/- 0.1 mm

I/O Connector

HDMI Connector-1	HDMI input
HDMI Connector-2	HDMI output
MINI USB Connector	Power/USB

Power Consumption

The power consumption differentials of operating modes are listed below.

Power Rails Operating Modes	5.0V		Total Power
	(V)	(A)	(W)
Idle Mode	5	0.12	0.6
Working Mode	5	0.12	0.6

Thermal

The case temperatures of key components are listed below.

Components	Components Case Temperature Specifications
C8051F850	TC: 95 ℃
CP2104	TC: 85 ℃

DC Input

Power Rails	5 V
Tolerance	+/- 5%
Current (Average)	0.5 A

LED Indicator

Color	Status
Red	Powered on
Green	(Auto Mode) Test passed

7. Introduction of Modes

The CT130 is an HDMI-signal-measuring and HDMI-signal-validating toolkit. To measure the TMDS differential signals, the CT130 integrates a signal switch that can direct the TMDS signal to either an output port (path 1) or a MCU (path 2).
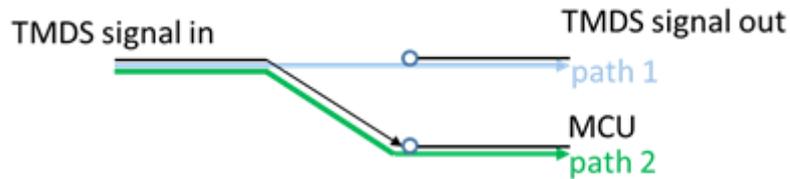
Figure 7-1 TMDS switch

The CT130 provides two modes for HDMI output signal validation:

1. MODE 1 - Auto Test Mode:

   In Auto Test Mode, the TMDS path is switched to path 2 (MCU) for measurement, then the CT130 detects whether an HDMI cable is plugged in or not. After an HDMI cable is plugged in, the CT130 starts to measure the DC voltages of HDMI signals (TMDS, power 5V). If all signals pass the validation, the TMDS switch changes to path 1 and the LED indicator turns **blue**. Otherwise, the TMDS path remains at path 2.

2. MODE 2 - PC-Operating Mode:

   In PC-Operating Mode, users can send a command to measure specific HDMI signal and then receive the measurement result or even perform an HDMI "hot plug action" via USB connection from a host PC.

Figure 7-2 CT130 MODE switch

8. Auto Test Mode

In Auto Test Mode, the TMDS path is switched to path 2 (MCU) at first, then the CT130 qualifies DC voltages of HDMI TMDS Data0+, TMDS Data0-, TMDS Data1+, TMDS Data1-, TMDS Data2+, TMDS Data2-, TMDS Clock+, TMDS Clock-, Power +5V according to specific criteria as follows:

HDMI POWER 5V：

1. $4.6V \leqq V_{avg} \leqq 5.4V$　Where V_{avg} = average DC voltage value.

TMDS signals：

1. $2.584V \leqq V_{avg} \leqq 3.216V$　Where V_{avg} = average DC voltage value.

The video output (TMDS signals) is temporarily blocked during the measurement and you will NOT see video through the CL511HN capture card. If all the above-mentioned DC voltages meet the criteria, the device under test (DUT) will be marked PASSED. Meanwhile, the TMDS path will be switched to path 1, and now the video (TMDS signals) will appear through the CL511HN capture card. On the contrary, the video will be blocked indefinitely if one of the DC values fails to meet the criteria. Once an HDMI cable is plugged in, the CT130 will start the measurement and qualification. Detail steps and qualification flowchart are listed below.

8.1 CT130 Auto Test Procedure and Steps

1. Switch to MODE 1.
2. Make sure the CT130 USB port is connected and the POWER LED is ON.
3. Connect the CT130 output port and the CL511HN input port using an HDMI cable.
4. Make sure the DUT is ON.
5. Connect the CT130 input port and the DUT output port using an HDMI cable.
6. After the HDMI cables are plugged in and 5 V power is detected, the CT130 will begin measuring and qualifying video.
7. After qualification:

7.1 If the HDMI power is less than 4.6V, the video will be blocked indefinitely.

7.2 If all DC voltages meet the criteria, the video (TMDS signals) will pass through to CL511HN. Otherwise,

7.3 The video will be blocked indefinitely if one of the DC voltages fails to meet the criteria.

8. If the video output appears within a few seconds (according to DUT. After TMDS signal shows up, the CT130 takes about 2.7 seconds to measure the signal), you can mark the DUT as PASSED. If not, mark the DUT as FAILED.

9. Repeat steps 4–8 to perform qualification for the next device.

9. PC-Operating Mode

The CT130 is equipped with a USB port, which provides not only power but a Virtual COM port for Windows operating systems. In PC-Operating Mode, users can send desired commands and receive the result of measurement through USB connection. The results are measured by Analog-to-Digital conversion with 10 k samples per second. The ADC chip provides 800 kbps sampling rate and ±70 mV deviation.

9.1 Connection Settings

To use the CT130 in PC-Operating Mode, you should install the USB to UART driver first. Unzip CP210x_VCP_Windows.zip to get the installer. After the installation, connect the device and the CT130 as shown in Figure 9.1-1.

9.2 UART Communication Protocol

The CT130 follows the Request-Reply strategy. In PC-Operating Mode, you can send a desired command after the connection has been established. When the CT130 receives a complete command, it starts the action as defined command and then replies the result to the host PC.

The serial settings are as follows:

Baud rate: 9600, Data: 8 bit, Stop bits: 1 bit, none parity & none flow control.

9.2.1 Request Command Format

The CT130 ignores the incomplete command within 550 msec. Request command format and command list are shown as below:

Table 1 Host Request Command Format

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Header	Command	Parameter		Checksum	
1 byte	1 byte	2 bytes		2 bytes	

Briefly description:

Header: 0x5A.

Command: As shown in Table 2.

Parameter: 0x0000, reserved for future use.

Checksum: (Byte 0 + Byte 1 + Byte 2 + Byte 3) & 0xFFFF.

Table 2 Request Commands

Command Code (Dec/Hex)	Name	Description
10/0x0A	TMDS differential signal D0+	Read ADC0 Value
11/0x0B	TMDS differential signal D0-	Read ADC1 Value
12/0x0C	TMDS differential signal D1+	Read ADC2 Value
13/0x0D	TMDS differential signal D1-	Read ADC3 Value
14/0x0E	TMDS differential signal D2+	Read ADC4 Value

15/0x0F	TMDS differential signal D2-	Read ADC5 Value
16/0x10	TMDS differential signal CK+	Read ADC6 Value
17/0x11	TMDS differential signal CK-	Read ADC7 Value
18/0x12	DDC_SDA	Read ADC8 Value
19/0x13	DDC_SCL	Read ADC9 Value
20/0x14	POWER +5V	Read ADC10 Value
21/0x15	Hot plug ADC value	Read ADC11 Value
22/0x16	CEC	Read ADC12 Value
33/0x21	control TMDS switch to path1	set TMDS switch pass through
34/0x22	control TMDS switch to path2	set TMDS switch to ADC detect
35/0x23	reset MCU	Reset MCU
37/0x25	FW version (BD & AP)	read FW version
41/0x29	Hot plug pull high	Pull hot plug to high level with RX
42/0x2A	Hot plug pull low	Pull hot plug to low level
43/0x2B	All ADC values	Read all ADC Values
46/0x2E	TMDS switch state	Read TMDS switch state
47/0x2F	MCU VDD Value	Read MCU VDD in Factory mode

For example, if you send a *0x5A0A00000064*, you'll receive a reply describing TMDS Data0+ DC value. Moreover, the CT130 can perform a hot plug by sending a *0x5A2A00000084*, delaying a few milliseconds and sending a *0x5A2900000083*.

NOTE: If you wish to obtain the CORRECT DC value, send a *0x5A220000007C* to make TMDS signal switch to path 2 (MCU) before sending any ADC command.

NOTE: The CT130 spends about 200 msec to start from "sending each Read ADC value command" to "getting the reply describing DC value". All other commands will be ignored during ADC measurement.

9.2.2 Reply Format

Once the operation is complete according to the request command, the CT130 replies the result with specific format as shown below:

a. If request command is one of the "read ADC values":

Table 3 Read ADC values Reply Format

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9
Header	Status	Max. DC value		Min. DC value		Avg. DC value		Checksum	
1 byte	1 byte	2 bytes		2 bytes		2 bytes		2 bytes	

Briefly description:

Header: 0xA5.

Status:

SUCCESS → Command requested

FAILURE → Error code as shown in Error Status

If any predictable situation happens, the CT130 will reply error status as follows:

Table 7

Max. DC value:

Maximum DC value in hexadecimal. Unit: mVolt.

Min. DC value:

Maximum DC value in hexadecimal. Unit: mVolt.

Avg. DC value: Average DC value in hexadecimal. Unit: mVolt.

Checksum: (Byte 0 + Byte 1 + ……… + Byte 7) & 0xFFFF.

For example, if you send a *0x5A0A00000064*, you'll receive a reply

0xA50A0C3F0A810B2101B1 describing TMDS Data0+ signal where:

Maximum DC value = *0x0C3F* = $(3135)_{10}$ mVolts

Minimum DC value = *0x0A81* = $(2689)_{10}$ mVolts

Average DC value = *0x0B21* = $(2849)_{10}$ mVolts

b. If request command is "read all ADC values":

The formats of replies are the same as "read ADC value" if the command is "read All ADC values" (0x2B), but the CT130 replies continuously after all ADC actions have been done. After every result has been replied, the CT130 will send a SUCCESS (0xA52B00000000000000D0) to PC. Figure 9.2.2-1 shows how it works.
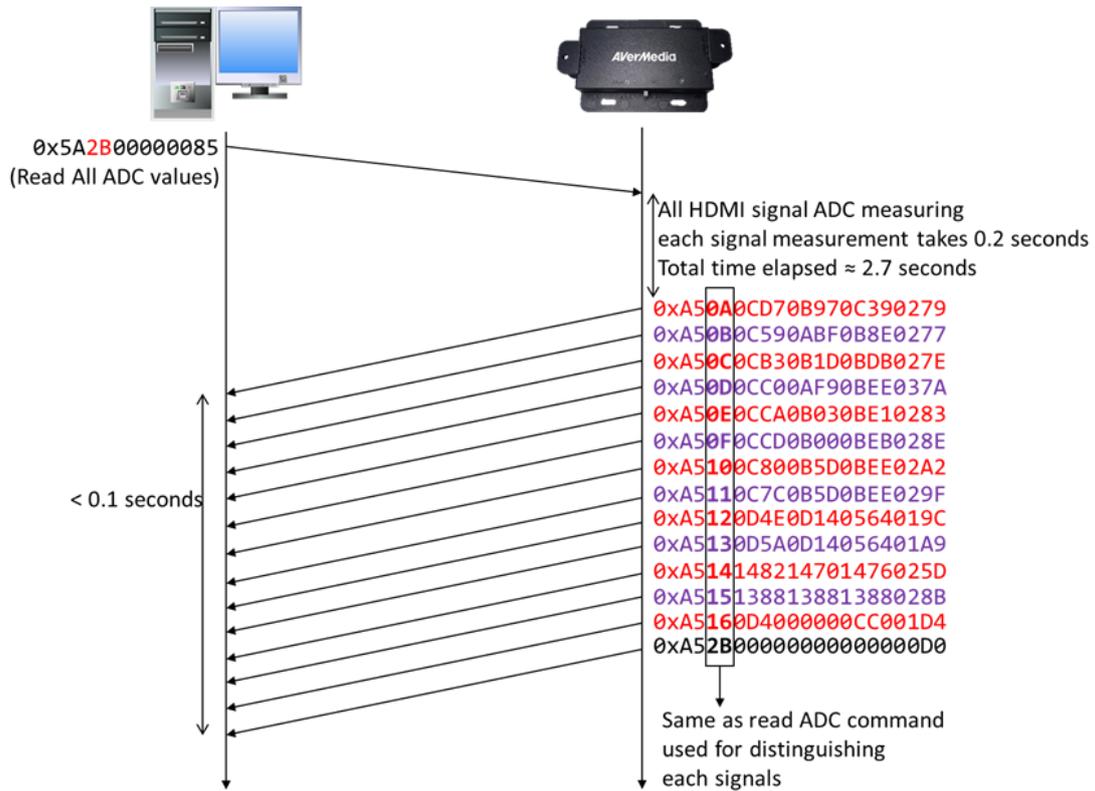
Figure 9.2.2-1 scenario of "Read all ADC values" command

c. If request command is "read TMDS switch state":

Table 4 Read TMDS switch state Reply Format

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9
Header 0xA5	Status 0x2E	Switch state		N/A		N/A		Checksum	
1 byte	1 byte	2 bytes		2 bytes		2 bytes		2 bytes	

Switch state:

0x0000 if state is path 1 (HDMI OUT)

0x0001 if state is path 2 (MCU)

d. If request command is "read F/W version":

Table 5 Read F/W version Reply Format

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9

Header 0xA5	Status 0x25	BD version	AP version	N/A	Checksum
1 byte	1 byte	2 bytes	2 bytes	2 bytes	2 bytes

BD version:

Bootloader F/W version "x.y" where   x = Byte 2 (major version in dec.)

y = Byte 3 (minor version in dec.).

AP version:

Application F/W version "x.y" where   x = Byte 2 (major version in dec.)

y = Byte 3 (minor version in dec.).

e. Other request commands:

Table 6 Other Commands Reply Format

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9
Header 0xA5	Status	N/A 0x0000		N/A 0x0000		N/A 0x0000		Checksum	
1 byte	1 byte	2 bytes		2 bytes		2 bytes		2 bytes	

Status:

SUCCESS → Command requested
FAILURE → Error codes listed in Error Status

If any predictable situation happens, the CT130 will reply error status as follows:

Table 7

9.2.3 Error Status

If any predictable situation happens, the CT130 will reply error status as follows:

Table 7 Error Codes

Error Code (Dec/Hex)	Name	Description
0/0x00	Checksum ERROR	Request checksum error
1/0x01	UNKNOWN command	Unknown request command

If users receive a *0xA50000000000000000A5* or a *0xA50100000000000000A6*, there might be communication or technical problems.

9.3   CT130 PC-Operating Procedure and Steps

1.   Switch to MODE 2.
2.   Connect a USB cable (A ←→ Mini-B) from PC to the CT130 USB port.
3.   Make sure the driver is installed and Virtual COM port appears in Device Manager.
4.   Make sure the POWER LED is ON.
5.   Setup the UART connection (driver, serial settings like baud rate, etc.)
6.   Connect an HDMI cable from the CT130 output port to the CL511HN input port.
7.   Make sure the DUT is ON.
8.   Connect an HDMI cable from the CT130 input port to the DUT output port.
9.   Send desired request command to the CT130 through UART.
10.   Wait for the CT130's reply then read the value.
11.   Repeat steps 9–10 to get all the information you need.
12.   Repeat steps 7–10 to perform test on the next device.

10. Update Application Firmware

Users can update the CT130's firmware via USB. The FW update setup is shown in Figure 10-1. The step-by-step firmware update can be found in 10.2 Firmware Update Procedure.

Figure 10-1 connect CT130 board to Host PC via USB port

10.1 Preparation

The CT130 software package contains:

USB to UART Bridge Driver—	**CP210x_VCP_Windows.zip.** This driver is developed by Silicon Lab. It drives USB to UART bridge chip function. So you must install this driver while you want to connect the CT130 to a PC via USB.
AVerMedia Updater AP—	**CT130Updater_V1.0.0.3_2014103001.exe**, AVerMedia Updater interface provides a friendly design and simple operation steps for firmware update. Please refer to the following procedure.

10.2 Firmware Update Procedure

1. Connect CT130 to PC via a USB, and switch to Mode 2 (PC-Operating Mode).

2. Run the **CT130Updater_V1.0.0.3_2014103001.exe** and message will prompt in the application window with steps to execute as in Figure 10.2-1.
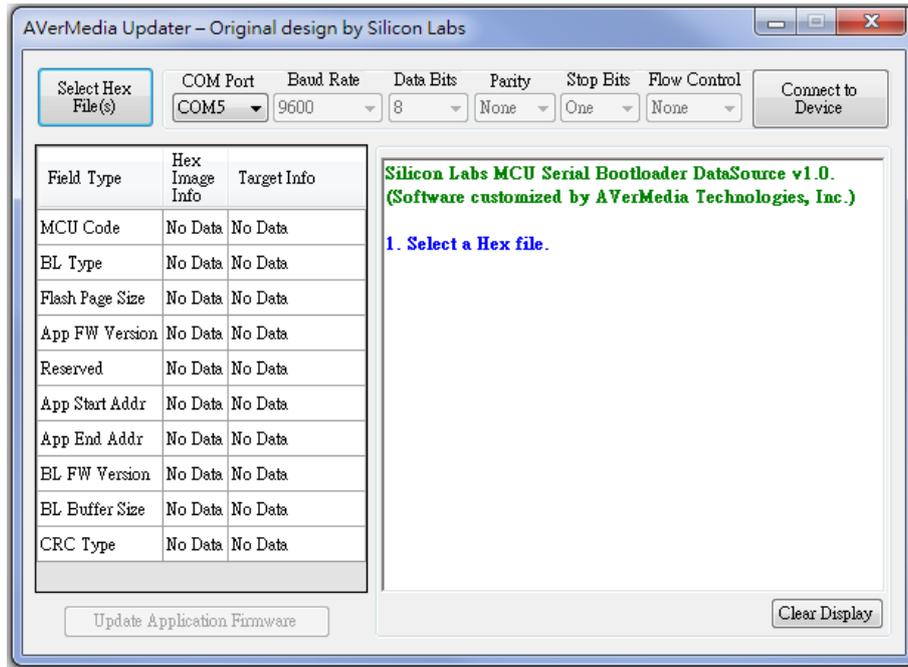
Figure 10.2-1 Running AVerMedia Updater Application Window

3. Select a Hex file:

Select a Hex file of firmware application code, it will show App FW Version in "Hex Image Info" Column of small box on the left side.
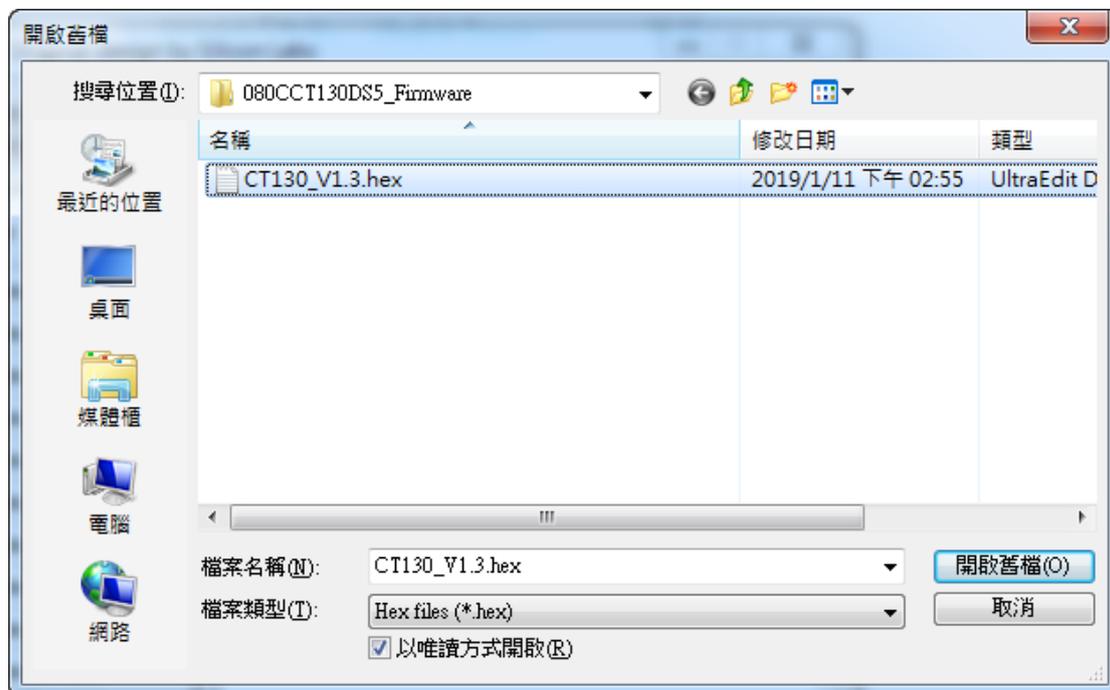

**Figure 10.2-2.1 Select Hex file**
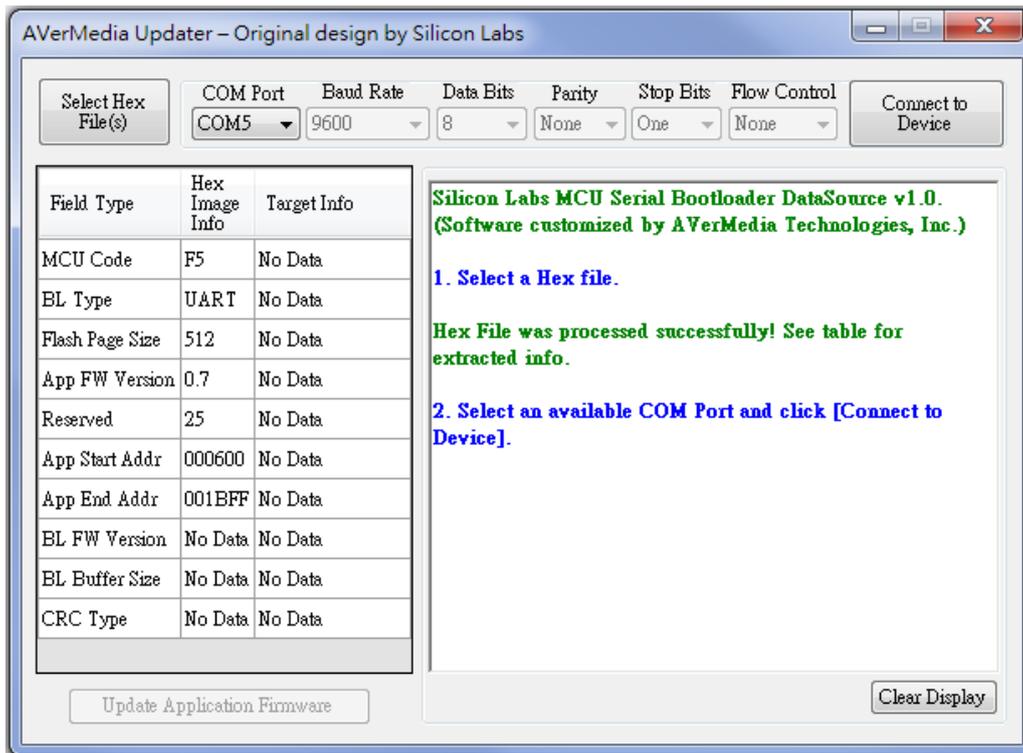
Figure 10.2-3.2 Select Hex file

4. Select a corresponding COM Port and click **[Connect to Device]**.

Select a corresponding COM port that connects the device (CT130 board), and click **[Connect to Device]**. If fails to connect the device (CT130 board), it will display a warning message as in Figure 10.2-4. Please re-plug the USB and try again.

After connecting the CT130 board, it will instruct the next step as in Figure 10.2-5 when it's ready to update the firmware application code.

It will show App FW Version and BL FW version of CT130 board in "Target Info" column of small box on the left side.
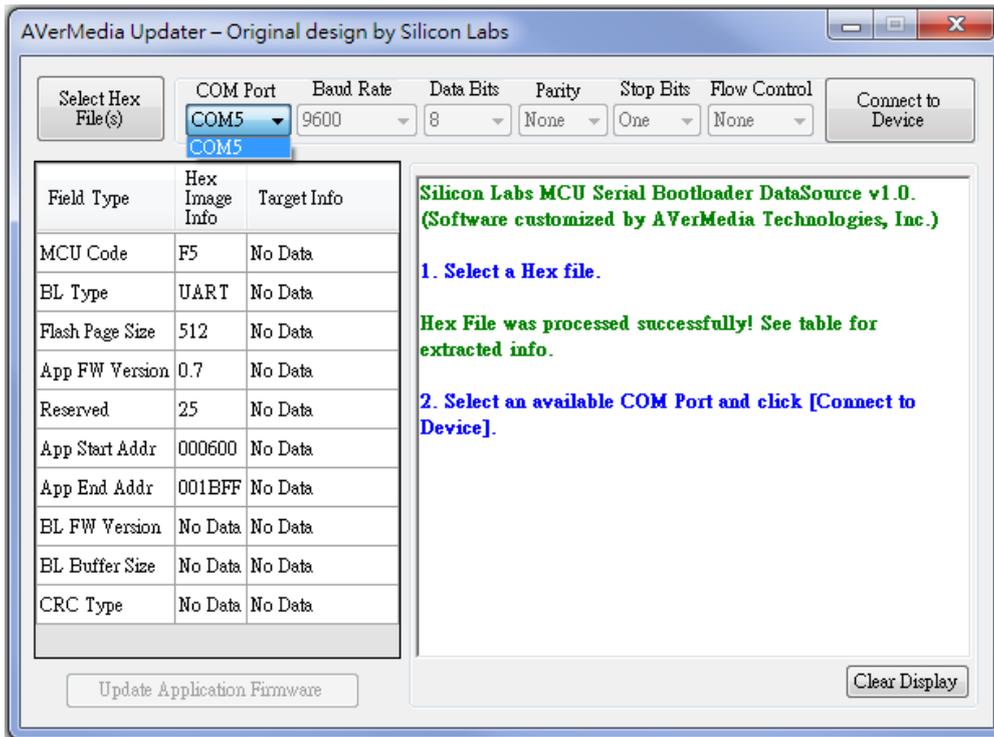
Figure 10.2-3 Open corresponding COM Port & Connect to device
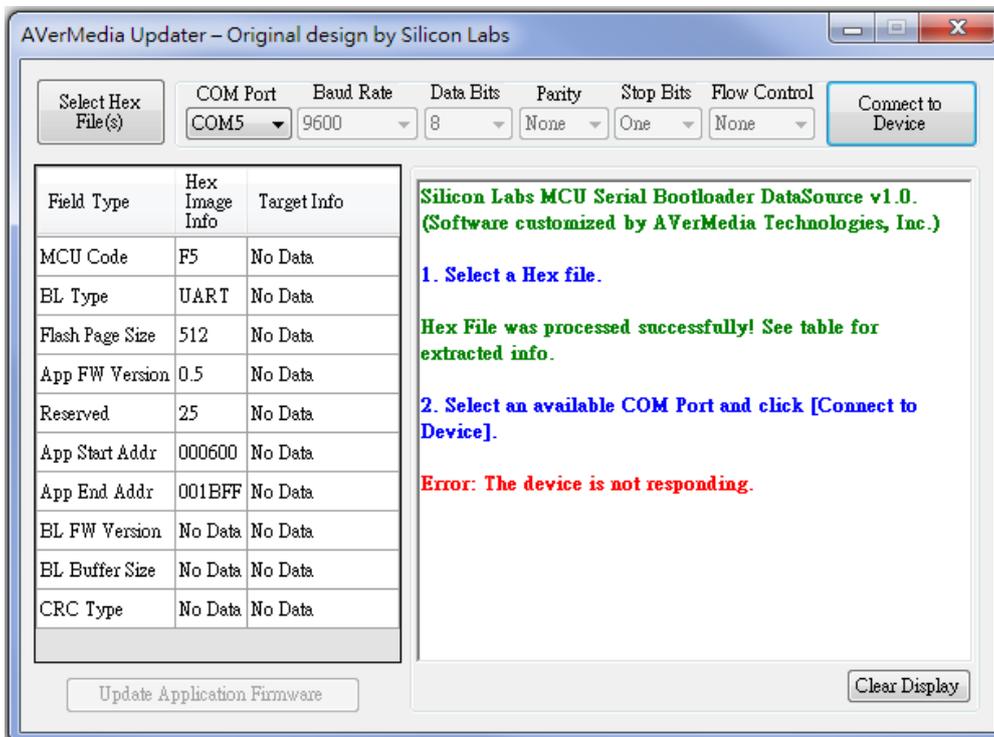
Figure 10.2-4 Connect to CT130 board failure

7. Click **[Update Application Firmware]** to download the selected application firmware (Hex file) to the CT130 board. See
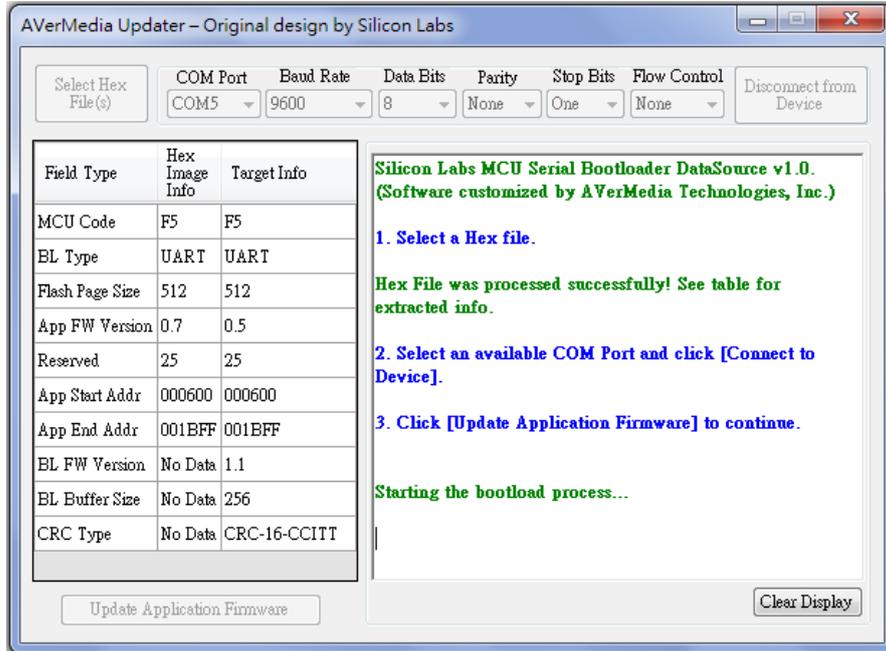

Figure 10.2-6.
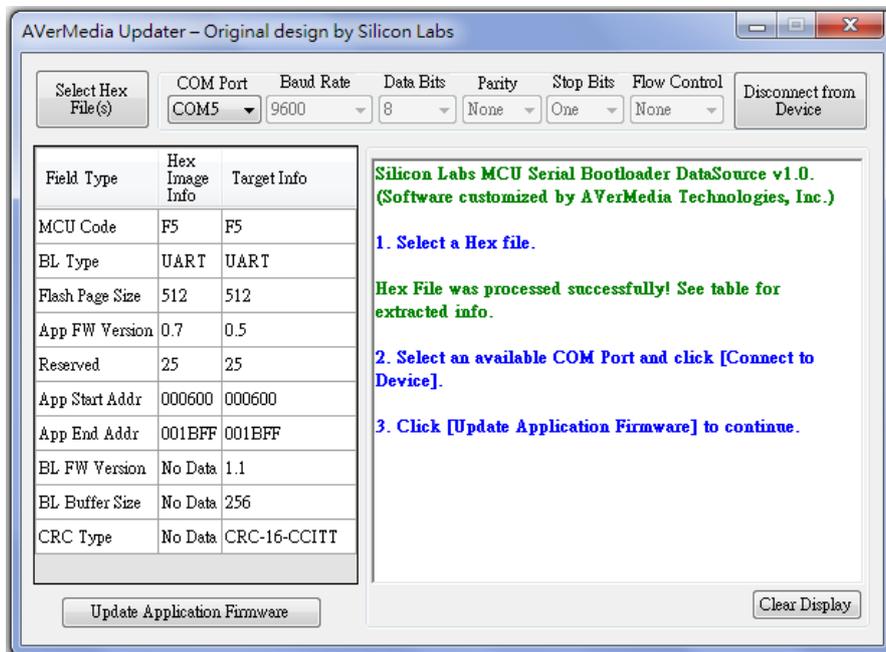
Figure 10.2-5 CT130 board ready to Update Application Code
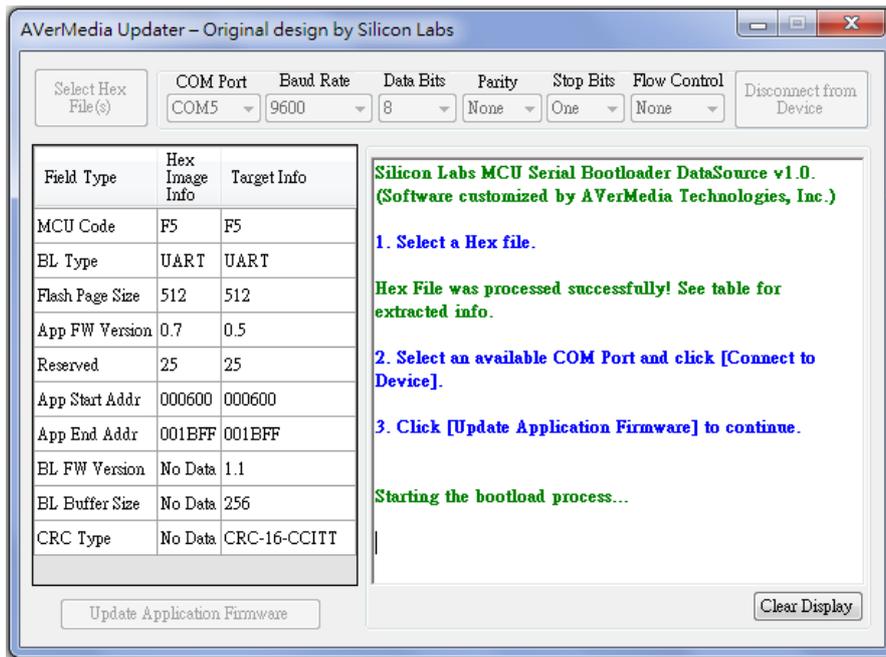
Figure 10.2-6 Downloading the Application Code

8. Once the update firmware application is done, it will display "Bootload process completed successfully!" message


(
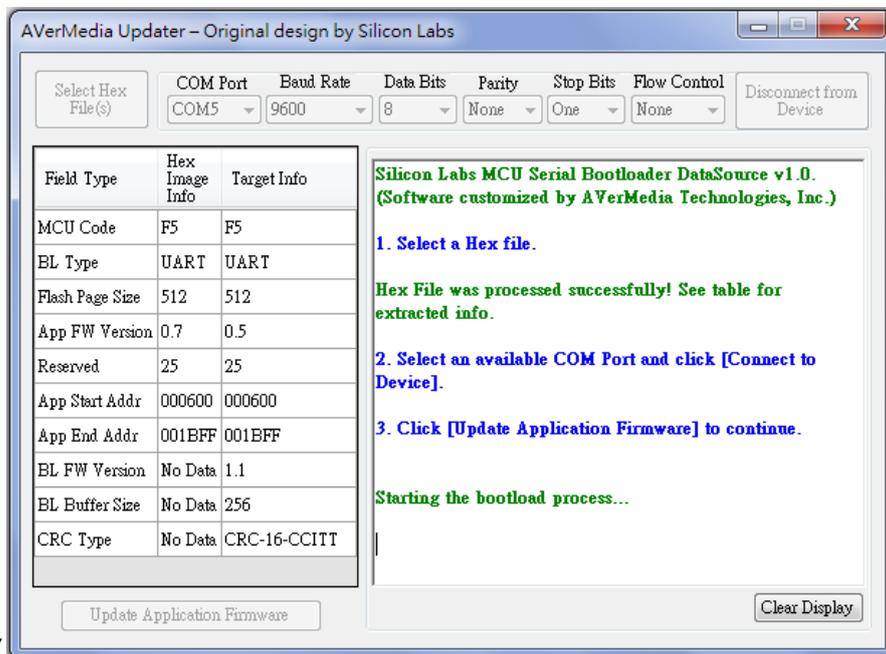
Figure 10.2-6) and the CT130 board will reset to start the application code and the host will disconnect from the device automatically.
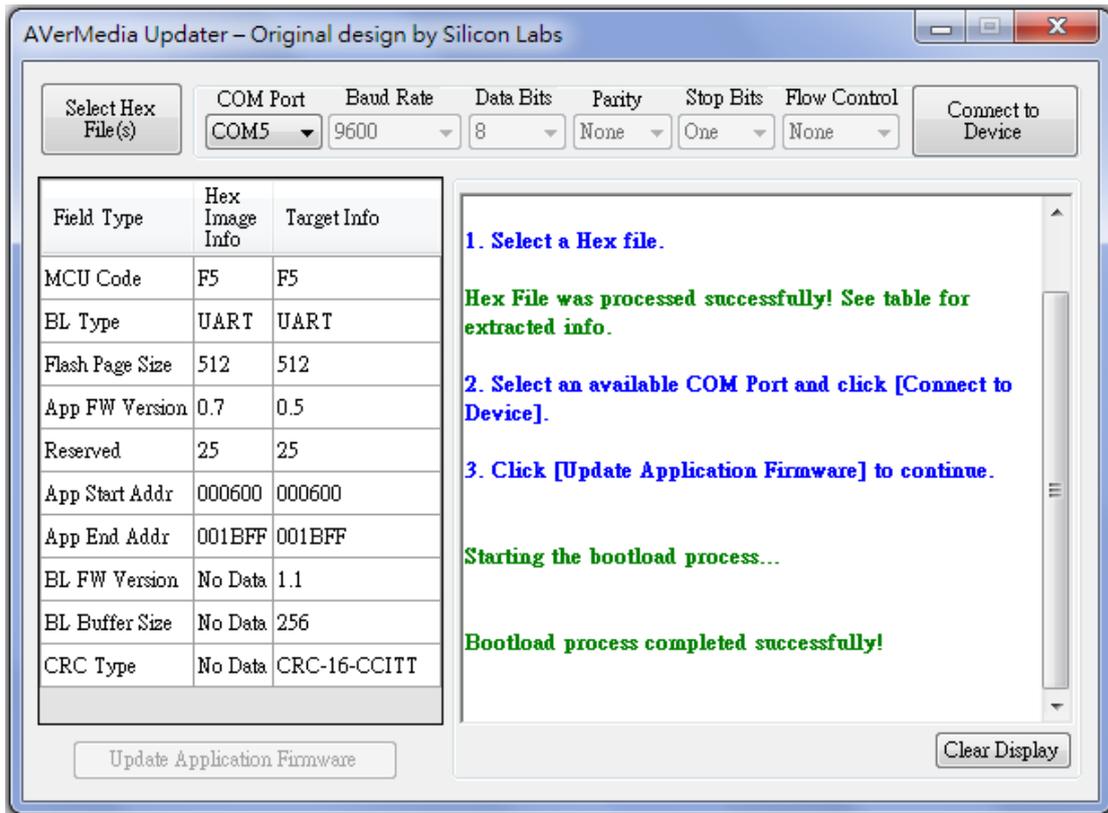
Figure 10.2-7 update new FW Application code successfully

9. If update firmware application code fails, please click **[Disconnect from Device]** then repeat steps 1–9.

10. If you want to update another CT130, please repeat steps 4–9.

11. If you want to update the CT130 with another hex file, please repeat steps 3–9.

10.3 One-click Updater

1. The Updater will load the last hex file in the working directory to update CT130 one by one.

2. Connect CT130 to PC via a USB, and switch to Mode 2 (PC-Operating Mode).

3. The hex file must be in the same directory to the **CT130Updater_V1.0.0.4_2014121801.exe**.

4. Run the **CT130Updater_V1.0.0.4_2014121801.exe** without any input and message will prompt in the console window as in Figure 10.3-1.

5. First, the Updater displays its version as shown in the red box 1.

6. The Updater displays the scanned serial ports and the name of last hex file as shown in the red box 2.

7. "Checking…" means that the Updater is checking whether the connected device is a CT130 device. If the connected device is not a CT130 device, "The device is not responding. It may not be a CT130 device." and "Connect failed!!" will be displayed as shown in the red box 3.

8. If the connected device is plug-off before "Checking…", "Could not open COM port. Original error: port 'COMX' does not exist" and "Connect failed!!" will be displayed as shown in the red box 4.

9. "It is a CT130 device." will be displayed, if the connected device is a CT130 device. "Updating…" means that the Updater starts updating. If the CT130 device is forced plug-off while updating, "Could not open COM port. Original error: port 'COMX' does not exist" and "Update failed!!" will be displayed as shown in the red box 5.

10. In normal case, "Update successfully!!" will be displayed at the end as shown in red box 6.

11. A CT130 device which update successfully will switch on blue LED.

Figure 10.3-1 One-click updater message

11. CE and FCC Compliance Statement

European Community Compliance Statement

Class B

This product is herewith confirmed to comply with the requirements set out in the Council Directives on the approximation of the laws of the Member States relating to Electromagnetic Compatibility Directive (EMC) 2014/30/EU.

FCC NOTICE (Class B)

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Federal Communications Commission Statement

NOTE- This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by tuning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

· Reorient or relocate the receiving antenna.
· Increase the separation between the equipment and receiver.
· Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
· Consult the dealer or an experienced radio/television technician for help.

CAUTION ON MODIFICATIONS

To comply with the limits for the Class B digital device, pursuant to Part 15 of the FCC Rules, this device must be installed in computer equipment certified to comply with the Class B limits. All cables used to connect the computer and peripherals must be shielded and grounded. Operation with non-certified computers or non-shielded cables may result in interference to radio or television reception.

Changes and modifications not expressly approved by the manufacturer or registrant of the equipment can void your authority to operate the equipment under Federal Communications Commission rules.

Signal Detector
Model: CT130
Made in Taiwan