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博睿康

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## Trigger Box

User manual



**Note:** Please read this instruction manual in its entirety before using the *Collect* acquisition software.

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## **Safety Information – Please read before use**


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### **Use this instruction manual**
















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This manual provides guidance on the installation, use, and daily maintenance of multi-modal TriggerBoxes. Users should read and ensure that they understand the content of this manual in detail before using this product, and operate in strict accordance with the instructions of this manual to ensure the safety and effectiveness of the operation. If you have any questions or comments about the use of the equipment, please contact Neuracle Technology (Changzhou) Co., Ltd.

The following general conventions are used in this manual:

Symbol	Illustrate
 <b>Warning</b>	“Warning” is an alert that indicates a potentially hazardous situation related to the use or misuse of a device that, if not avoided, could result in serious injury or death.
<b>Attention !</b>	“Attention” is an alert that indicates a potentially hazardous situation related to the use or misuse of a device that, if not avoided, could result in minor or moderate injury. It can also be used to warn of unsafe behavior or potential equipment damage.
<b>Suggest:</b>	Provide users with an explanatory prompt for ancillary information that they are interested in.

## Description of the symbol

Symbol	Illustrate
	Consult the instruction manual when using
	Manufacturer
	The user should consult the important warning information of the instructions for use
	Power button
	Wireless
	Do not soak
	Do not expose to the sun
	Avoid rain
	Temperature limits
	Placed upwards
	Handle with care
	Fragile
	Serial number
	Date of manufacture
	Do not throw it away



## Safety Guidelines

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- ✧ This product should be operated and maintained in strict accordance with the safety precautions and instructions for use specified herein.
- ✧ This product must be installed, maintained and repaired by a Bricom approved technician.
- ✧ It is forbidden to modify the system in any way; Any attempt to disassemble, repair or modify this product by any person other than BrightKang's authorized service technician may pose a risk to the test subject or operator and may result in damage to the equipment; Equipment that has been dismantled, repaired, altered or modified by non-authorized personnel is not covered by the Priicon Warranty and is not guaranteed in any way.
- ✧ If there is an unsafe condition, the use of the product is prohibited.
- ✧ If the product fails, stop the operation immediately and contact the authorized service technician.

## Warnings and precautions

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When using this product, please observe the following and the warnings and precautions in each section. Other relevant warnings will be prompted and explained in the relevant sections of each chapter of this manual.



### Warning

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- It is forbidden to connect any item or device that is not part of this product to be used in conjunction with this product without the consent of *Neuracle*, and the device should not be stacked with other devices,

and if it must be stacked, it should be observed and verified to function properly under the configuration it is used in.

- Do not pour liquids such as water or beverages into the equipment, as this may cause electrical and machine parts to malfunction, which may lead to accidents, fires or equipment malfunctions.

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### Attention!

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- Do not violently impact this product, and do not drop any part of this product.
- The equipment is a precision electronic product, please waterproof, moisture-proof, dust-proof, keep it clean and dry.
- When the ambient temperature and humidity of the product are stored or used beyond the range specified by the manufacturer, the performance may be affected.
- Please dispose of the scrapped equipment in accordance with the provisions of the relevant local environmental protection laws and regulations, and do not pollute the environment.
- When unplugging cables and accessories, grasp the plug part instead of pulling the cable directly.

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### Electrical safety

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- ✧ If a broken wire or cracked wire is detected, it is forbidden to operate the equipment. Please contact the after-sales service personnel in time for maintenance and repair.
- ✧ Conductive liquid flowing into the active circuit components of the product may cause short circuits.

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### Electromagnetic interference safety

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This product generates and radiates radio frequency energy. The device can cause radio frequency interference to other equipment as well as to radio communication devices. This product provides reasonable protection against such interference. If you suspect that the product is interfering with other nearby electrical equipment, turn off the product to see if the interference clears. If it is determined that the product is a source of interference, the product or adjacent equipment can be sub-shielded or relocated as necessary.

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## **1. overview**

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### **1. 1. Product Description**

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The TriggerBox is an auxiliary support device developed and designed by Neuracle Technology (Changzhou) Co., Ltd. for the needs of neuroelectrophysiology experiments.

This product can synchronize various types of events such as sound, light, and program output with neuroelectrophysiological data with high enough time accuracy (<1ms) to provide a core basis for subsequent data analysis.

The TriggerBox is an important component of the Mindful Lab system, which can be synchronized with other physiological signals.

### **1. 2. Applicability**

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This product is used for the simultaneous study of multimodal data of multiple people with the portable multi-modal synchronous acquisition equipment of neuracle, which is only used for laboratory neuroscience research and shall not be used as a medical device, and only technicians who have received relevant professional training and qualified can use this product.

### **1. 3. Product Models and Versions**

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The corresponding product model of the TriggerBox is NDE0001.

### **1. 4. Operating Environment**

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✧ Ambient temperature: +5°C~+40°C

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- ✧ Relative humidity: 30%~75% (no condensation)
  - ✧ Atmospheric pressure: 700hpa~1060hpa
  - ✧ Power requirements: 5V-2.0A

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## 2. Product structure and functional description

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### 2.1. Overview of the product structure

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TriggerBox description:



Figure 1 Schematic diagram of TriggerBox structure

### 2.2. TriggerBox

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The TriggerBox is the core system control and data processing center, which records and processes the data received from each sensor or interface and transmits it to the computer via Wi-Fi or wire. The TriggerBox does not have a switch button, and it is powered on by using the USB3.0 interface

The following table describes the information about each interface:

Number	The name of the structure	Feature description
1)	USB connector	It is used for power supply of equipment + data transfer with computer via USB cable

2)	LAN port	You can connect to a computer via a network cable or to a router
3)	Power connector	It is used to power the equipment
4)	RSS port	Analog output, self-test stacked ERP, used to connect EEG amplifier to verify the effectiveness of synchronization; Look at the deviation of the signal and the timestamp
5)	N.TRIG port	with N. TRIG transponder; compatible with external devices
6)	EVENT I/O port	Event box interface: the event probe is connected to receive the events generated by the event box. Connect the trigger forwarding line
7)	EVENT I/O port	Event box interface: the event probe is connected to receive the events generated by the event box. Connect the trigger forwarding line
8)	SD card	Offline storage

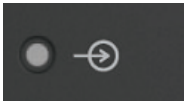

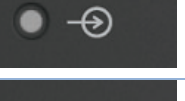
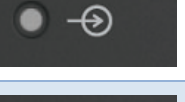
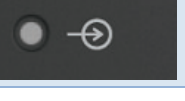
### 2. 3. Event box

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Figure 2 Extended Triggerbox I

The following table describes the information about each interface:

Number	The name of the structure	Feature description
1)		Data transmission + power supply + synchronous signal reception; It can be connected with the EEG host connection/TriggerBox for the transmission of events.
2)		Data transmission + power supply + synchronous signal reception; It can be connected with the EEG host connection/TriggerBox for the transmission of events.
3)		Support TriggerIN, TriggerOut, light sensitive, and key random events
4)		Support TriggerIN, TriggerOut, light sensitive, and key random events
5)		Support TriggerIN, TriggerOut, light sensitive, and key random events



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### 3. Directions for use

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Before the system experiment, it is necessary to connect and set the TriggerBox according to the different stimulation modules and the different experimental requirements, and this part is introduced separately according to the different stimulation modules.

#### **3.1. Three communication methods between the TriggerBox and the PC and the DCP protocol**

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The PC and TriggerBox can communicate through the USB interface, the 4321 port of wireless wifi, and the 4321 port of the wired LAN port, and the communication interface implements the hexadecimal (hex) DCP protocol. The specific configuration steps are as follows:

##### **3.1.1 Serial communication and DCP settings**

- 1) Connect the serial port cable between the TriggerBox and the PC, and turn on the power supply of the TriggerBox; If the TriggerBox can work properly, you can use the serial port debugging tool to discover the COM port used by the TriggerBox.
- 2) Configure COM communication parameters: 115200bps, 8-bit data bit, 1-bit stop bit, check bit none, no flow control.

The serial port commands sent by the PC are defined in the DCP protocol following the format shown in the figure:

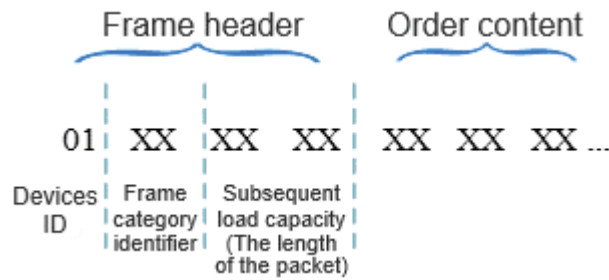


Figure 3 DCP command format

According to the content of the DCP protocol, the PC realizes the output of custom events using the USB port, the information of the device and the attached sensor, as well as the query and configuration of sensor parameters.

### 3.1.2 Wireless wifi port 4321 and DCP settings

Open SSCOM or other tools with TCP connection, as shown in the following example, select the TCPClient port, remotely fill in the IP address of the target TriggerBox, ending of the port number is 4321, and click Connect. The protocol of the DCP is defined as a general protocol, which is the same as that of the serial port and the LAN port.

The screenshot shows a form with two input fields. The first field is labeled 'Dest IP' and contains the value '127.0.0.1'. The second field is labeled 'Dest Port' and contains the value '4321'. Both fields have a dropdown arrow on the right side.

Dest IP	127.0.0.1
Dest Port	4321

Figure 4 Parameter settings

### 3.1.3 Port 4321 and DCP settings of the wired LAN port

The wired network connection mode can form a LAN through the router to connect the TriggerBox and the computer through the network cable, or the TriggerBox can be directly connected to the computer network port. Note: When connecting through a router, you

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can set the TriggerBox through the DCP protocol to obtain the IP address, which is divided into two modes: static IP (default 192.168.1.100, static address can be modified through DCP) and dynamic IP (in this case, the IP needs to be automatically assigned to the TriggerBox through the router DHCP). If you don't know the IP address of the LAN port of the TriggerBox, you can change the IP address through the USB serial port.

After knowing the IP address of the LAN port of the TriggerBox, the operation steps are the same as the wifi steps, and you can use SSCOM to connect to the target IP and port 4321.

After the above configuration is completed, by sending the "01 04 00 00" command, the serial port software will receive the self-described message "01 04 11 00 54 72 69 67 67 65 72 42 6F 78 2E 54 69 74 69 6E 67", where "54 72 69 67 67 65 72 42 6F 78 2E 54 69 74 69 6E 67" corresponds to the ascii character "TriggerBox.Titing".

### 3.2. TriggerBox supports DCP command description

**Note: The following is the DCP command for setting the TriggerBox's own parameters, and the DCP command supported after mounting the event box is written in Section 4. All instructions are in Hex, i.e. hexadecimal number representation.**

#### 3.2.1 Output the trigger time command

✧ **Output a trigger event in real time:**

**01 E1 01 00 XX**

[Wherein, XX: the output Trigger value, the value range (0~FF, that is, 0~255), specified by the user.] This command will stop the

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periodic output of the Trigger event that is currently in progress.]

✧ **Periodically output a Trigger event (hexadecimal format):**

**01 E7 04 00 AA XX TL TH**

[Among them, AA: value range (00~01). A value of 00 indicates that the output of periodic events is stopped, and a value of 01 indicates that the output of periodic events is started. XX: value range (00~FF, i.e., 0~255), the output Trigger value, specified by the user. T: period value, in milliseconds, the value range (1~FFFF, i.e., 1~65535 milliseconds), specified by the user. TL: 8 bits lower than the period value, TH: 8 bits higher than the periodic value.]

### **3.2.2 Output DAC commands**

✧ **Output DAC waveform:**

**01 E6 01 00 XX**

[XX: value range (00~01), 00 off, 01 on, specified by the user.]

### **3.2.3 Output DAC waveform selection**

✧ **Change the output DAC waveform:**

**01 10 01 00 XX**

[Wherein, XX: value range (01~02), 01 sine, 02 square wave, specified by the user.]

### **3.2.4 Wired LAN settings**

✧ **Dynamic IP Settings:**

**01 11 01 00 01**

[After setting, the TriggerBox will be powered on and the dynamic

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IP will be selected by default]

✧ **Static IP Settings:**

**01 11 01 00 00 XX XX XX XX**

[XX XX is the hexadecimal system corresponding to the IP address, after setting, the default LAN port is the set IP when the TriggerBox is turned on. If you need to set the static IP address to 192.168.1.58, it should be C0 A8 01 3A.]

### **3.3. Description of the hardware interface and indicator of the TriggerBox**

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#### **3.3.1 USB connector (serial port)**

Note: If the plugged USB port only provides communication but does not provide power supply, please connect the power port of the TriggerBox to the power supply to ensure that the power supply is normal.

Usage scenario: Used for DCP commands to configure some functions of the TriggerBox.

The USB port (serial port) configuration is shown in the following figure, and HEX display and HEX transmission need to be checked.

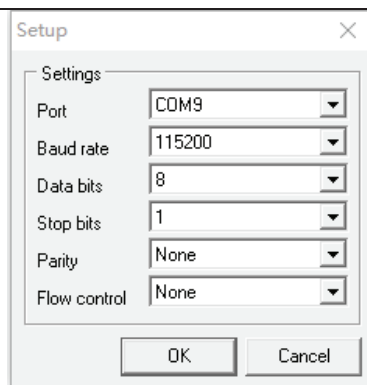


Figure 5 Serial port configuration

### 3.3.2 Network port (LAN port)

Note: When using the network port, you need to turn off the wifi first. Dynamic IP is only available if the switch or router supports the DHCP protocol.

Usage scenario: Wired networks are disabled or used in environments with poor wireless environments.

Network port configuration: Dynamic or static IP configuration can be carried out according to the DCP provided above, and the computer can be connected to the IP address of the TriggerBox by restarting the TriggerBox after configuration.

### 3.3.3 RSS port

Note: A special matching interface cable is required

Usage scenario: analog output, self-test stacked ERP, used to connect

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EEG amplifier to verify the effectiveness of synchronization; Look at the deviation of the signal and the timestamp.

ANALOG OUT interface configuration: After the matching cable is connected to the interface, open the serial port, send the corresponding DCP command, and periodically output a Trigger event in real time: 01 E7 04 00 01 XX TL TH, and then send the output DAC command: 01 E6 01 00 XX, the instruction has been explained above.

#### 3.3.4 N. TRIG port

Note: If you need to use the CAN marking function, you need to use the supporting USB to CAN small module and CAN HUB. If only wired synchronization is required, a companion cable is sufficient.

Scenario: When multiple computers are needed and the event is triggered by which computer, the USB to CAN marking module is used to connect to the CAN HUB, AND THE CAN HUB is connected to the N-TRRIG port.

Note: If you need to use the marking function of multiple USB to CAN modules, you need to configure the ID of each USB to CAN module through the DCP command to facilitate distinction, otherwise it will default to the same ID.

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The USB to CAN cable is shown in the image:



Configure COM communication parameters: 1 Mbit/s, 8 bits of data, 1 bit of stop, none, and no flow control.

Output a Trigger event in real time:

01 E1 01 00 XX

### **3.3.5 EVENT I/O(1)(2) port**

Note: A matching interface cable is required to be used with the corresponding event box.

Usage scenario: When external events such as keys, light sense, and sound sense need to be used.

Interface configuration: Only an external event box needs to be inserted, and the event box indicator light is always on, which means that the connection and communication are normal.

### **3.3.6 SD card**

Note: When the TriggerBox is working with other devices, it is recommended not to pull out the SD card to prevent data leakage.



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Usage scenarios: (1) The host computer will enable offline storage, and the TriggerBox will store the data related to the experiment. (2) Used to view the network segment of the TriggerBox. The TriggerBox will record the connected network segment in real time and save it to the SD card in txt format, and you can check the SSID after opening the file.

SD configuration: You only need to insert an SD card with the standard size.

#### 3.3.7 5mm power supply port

Note: The power supply is 5V DC, and when both the power supply port and the USB port are connected, the 5mm power supply port is used for power supply by default

Usage scenario: When the power supply capability of the USB port is insufficient

#### 3.3.8 Indicator

The indicator above the TriggerBox is the WIFI indicator, flashing in the connection, solid on when connected, and always off when disabled.

The indicator light below the TriggerBox is the SD card indicator light, which is always off when not inserted, and always on when inserted.

The PC and the TriggerBox can communicate through the USB interface, which executes the hexadecimal DCP protocol. The specific configuration steps are as follows:

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1) As described in 3.2, connect the serial port cable between the TriggerBox and the PC side, and turn on the power supply of the TriggerBox.

2) Configure COM communication parameters: 115200bps, 8-bit data bit, 1-bit stop bit, check bit none, no flow control.

The serial port commands sent by the PC are defined in the DCP protocol following the format shown in the figure:

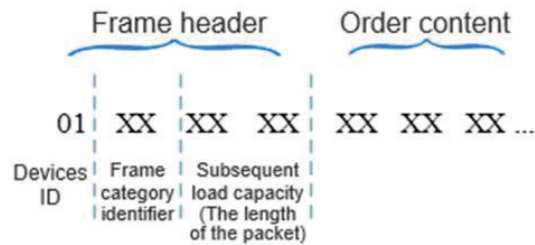


Figure 6 DCP Protocol Command Format

According to the content of the DCP protocol, the PC realizes the output of custom events using the USB port, the information of the device and the attached sensor, as well as the query and configuration of sensor parameters.

### 3.4. Description of the DCP command supported by the event box TriggerBox

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A photocell is used as an example to illustrate the use of an event box.

#### 3.4.1 Light Sensor connection

The Light Sensor is directly or indirectly connected to the TriggerBox via an event box. In this case, the Light Sensor connected under the TriggerBox can be used in two ways, and these two methods can be

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used at the same time:

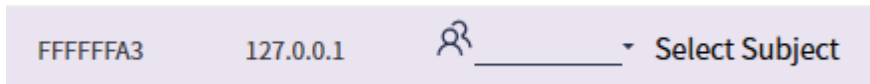


Figure 7 How to use the software

(1) Access the Light Sensor cell device through the IP address and port 4321 of the TriggerBox. In this case, you need to find the IP address of the TriggerBox. For example, in the preceding figure, the IP address of the TriggerBox is 192.168.31.103. You can use the TCP client to connect to port 4321 under this IP address, and after the connection is successful, you can use the following instructions to send commands and receive command replies to configure and use the device.

(2) The TriggerBox is connected to the PC through a serial port cable, and the Light Sensor is accessed through the serial port generated on the PC side (see the instructions for the TriggerBox for details). Find the sequence number of the COM port corresponding to the TriggerBox, and use the serial port parameter configuration (115200bps, 8 bits of data, 1 bit of stop, check bit none, no flow control) to establish a connection with the TriggerBox. Once the connection is successful, you can configure and use the device by sending commands and receiving command replies using the instructions below.

The communication protocol of Light Sensor follows the DCP protocol format, i.e. (including the sending and receiving of commands):

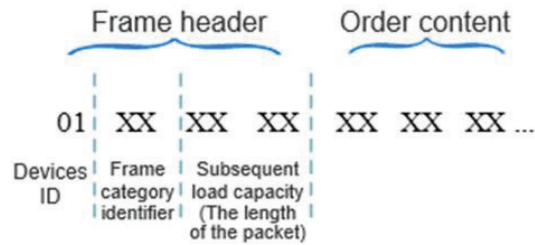


Figure 8 DCP command format

### 3.4.2 Obtain real-time sampling values of photocells

✧ Real-time acquisition of primary photocell sampling values:

**01 05 02 00 02 01**

The command replied:

**01 05 04 00 02 01 AL AH**

[Where A is the sampling value of the photocell, where AL represents the lower 8 bits of the sampling value, and AH represents the upper 8 bits of the sampling value.] The effective sampling value range is 0~0xFFF]

### 3.4.3 Enable the photocell monitoring function

✧ Initiating photocell monitoring:

**01 02 0A 00 02 01 XX YY AL AH BL BH CL CH**

[Among them, XX is the event trigger type, XX: 01 is triggered only on the rising edge (triggered after the sample value jumps from below the threshold to above the threshold), 02 is triggered only on the falling edge (the sample value is triggered after the sample value jumps from above the threshold to below the threshold), and 03 is

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triggered on both the rising edge and the falling edge (the sampling value jumps from below the threshold to above the threshold, or the sampled value is triggered after the sample value jumps from above the threshold to below the threshold); YY: reserved field, 1 must be filled; A: The number of triggers, where AL indicates the lower 8 digits of the trigger times and AH indicates the higher 8 digits of the trigger times. In particular, when A takes 0xFFFF, it means that the number of triggers is not counted for continuous triggering. B: trigger threshold, where BL represents the lower 8 bits of the trigger threshold, BH indicates the upper 8 bits of the trigger threshold, and the effective threshold value range is 0~0xFFF; C: The event value at the time of triggering, where CL represents the lower 8 bits of the event value at the time of triggering and CH represents the 8 bits higher of the event value at the time of triggering.]

The command replied:

**01 02 02 00 02 01**

#### **3.4.4 Disable the photocell monitoring function**

✧ **Stop ongoing photocell monitoring:**

✧ **01 02 0A 00 02 01 00 00 XX XX XX XX XX XX**

[Where, XX: arbitrary.]

Command reply:

**01 02 02 00 02 01**

#### **3.4.5 Obtain the monitoring parameters of the photocell that are currently configured**

✧ **Obtain photocell monitoring parameters:**

---

**01 01 02 00 02 01**

Command reply:

**01 01 08 00 XX YY AL AH BL BH CL CH**

[Among them, XX is the event trigger type, XX: 01 is triggered only on the rising edge (triggered after the sample value jumps from below the threshold to above the threshold), 02 is triggered only on the falling edge (the sample value is triggered after the sample value jumps from above the threshold to below the threshold), and 03 is triggered on both the rising edge and the falling edge (the sampling value jumps from below the threshold to above the threshold, or the sampled value is triggered after the sample value jumps from above the threshold to below the threshold); YY: reserved field; A: The number of triggers, where AL indicates the lower 8 digits of the trigger times and AH indicates the higher 8 digits of the trigger times. In particular, when A takes 0xFFFF, it means that the number of triggers is not counted for continuous triggering. B: trigger threshold, where BL represents the lower 8 bits of the trigger threshold, BH indicates the upper 8 bits of the trigger threshold, and the effective threshold value range is 0~0xFFF; C: The event value at the time of triggering, where CL represents the lower 8 bits of the event value at the time of triggering and CH represents the 8 bits higher of the event value at the time of triggering.]

### **3.5. The USB interface outputs the Trigger event in real time**

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Real-time output of Trigger events via the USB interface is done via

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the USB cable of the TriggerBox itself, without relying on other cables or sensor devices.

### **3.5.1 Connectivity and configuration**

The TriggerBox Micro-USB interface is connected to the USB port of the PC (as shown in the figure), and the COM port is virtualized on the PC side, indicating that the connection is successful.



Figure 9 Schematic diagram of USB and PC connection

The USB connection can supply power at the same time, so if you use a network cable instead of a serial port, you should use the power cable at the same time.



Figure 10 Schematic diagram of the connection between the network cable and the PC

SSCOM V5.13.1 is a simple and free serial port test program, unless otherwise specified, all demonstrations of the TriggerBox serial DCP protocol in this document are performed under this software. The software can be found on the included USB stick.

Open the SSCOM V5.13.1 software, and the TriggerBox will provide a COM communication port named "COMxx USB Serial Port", where "COMxx" is the actual virtual COM port serial number, as shown in the figure.

In the Port Number drop-down list, select the TriggerBox serial port that the software automatically searches for, and select 115200 from the Baud Rate drop-down list. Note that according to the requirements of the COM communication parameters of the DCP protocol, configure the serial port debugging assistant parameters



[serial port sending mode and receiving mode must check HEX sending and HEX display, otherwise TriggerBox will not recognize the command], after the configuration is complete, click "Open serial port", as shown in the figure.

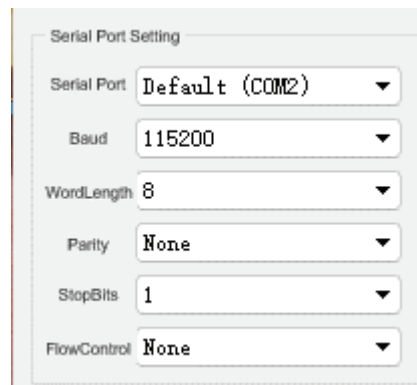


Figure 11 Serial Port Debugging Tool Configuration

After the above configuration is completed, by sending the "01 04 00 00" command, the serial port software will receive the self-describing message "01 04 11 00 54 72 69 67 67 65 72 42 6F 78 2E 54 69 74 69 6E 67", wherein, "54 72 69 67 67 65 72 42 6F 78 2E 54 69 74 69 6E 67" corresponds to ASCII characters TriggerBox.Titing”。

### 3.5.2 Instruction Description

✧ **Output a Trigger event in real time:**

**01 E1 01 00 XX**

[Where, XX: the output Trigger value, specified by the user.]

✧ **Periodically output a Trigger event:**

**01 E7 04 00 01 XX TL TH**

---

[Where, XX: the output Trigger value, specified by the user; T: period value, in milliseconds, specified by the user; TL: 8 bits lower than the period value, TH: 8 bits higher than the periodic value.]

### 3.5.3 MATLAB program

1) Generate the class TriggerBox.m

The constructor of the TriggerBox class is TriggerBox(port, tcpPort), where the port is the port number of the TriggerBox, and the string type, such as 'COM3', can also be empty, which will automatically find the port number of the connected TriggerBox; tcpPort is an internal tcp port that needs to be used in some special cases, and is empty during normal use.

2) Output Trigger

In this class, the function used to output the trigger time of the serial port is OutputEventData(obj, eventData), obj is the class object, and the value of the trigger output by eventData is an integer in the range of 0-255 (uint8).

3) Use the sample

```
t=TriggerBox();  
for i = 1:100  
    t.OutputEventData(i);  
    pause(1);  
end
```

## 3. 6. Light Sensor monitoring of the Trigger event

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The optical signal is collected by the matching Light Sensor, which is pasted to any position in the computer screen for signal acquisition of light intensity change. The default working mode of the sensor is rising edge triggering, that is, when the light intensity changes from

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dark to strong and exceeds a preset threshold, the sensor is triggered to send an event message at the moment when the light intensity changes beyond the threshold.

#### **3.6.1 connect**

The TriggerBox Micro-USB interface is connected to the USB port of the PC, and the COM port is virtualized on the PC, indicating that the connection is successful.

The TriggerBox Light Sensor connector plugs into the photocell cable connector, and the Light Sensor is attached to a specific area of the screen (as determined by the user's stimulator). The connection is completed as shown in the diagram:



Figure 12 Schematic diagram of Light Sensor connection and use

#### **3.6.2 Instructions for using the process**

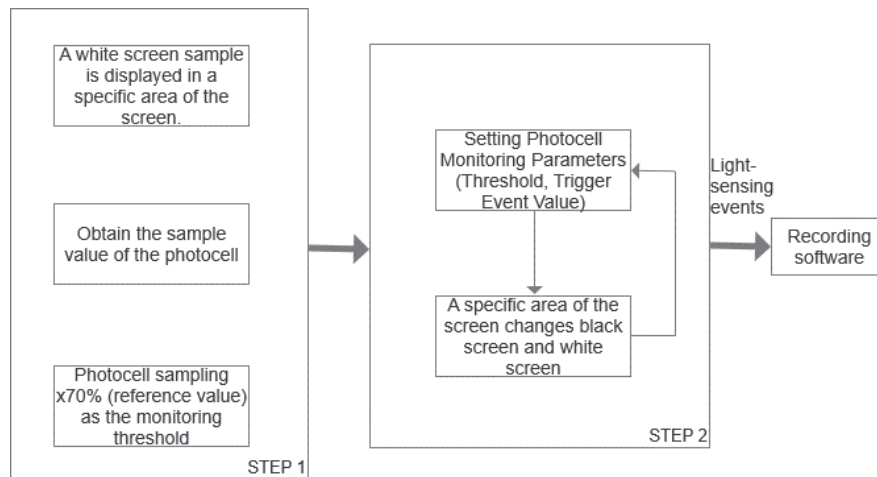


Figure 13 Flow chart of the use of the photocell monitoring trigger

### 3.6.3 Instruction Description

#### ✧ Obtaining Photocell Sampling Values (DCP\_FunctionID\_SensorParaGet)

Send instructions on the PC side:

**01 05 02 00 02 01**

TriggerBox returns the command:

**01 05 04 00 02 01 XXL XXH**

[Wherein, XX: photocell sampling value, XXL: sampling value 8 bits lower, XXH: sampling value 8 bits higher.]

#### ✧ Set the monitoring parameters of the photocell

Send instructions on the PC side:

**01 02 0A 00 02 01 01 03 01 00 XXL XXH YYL YYH**

---

[Wherein, XX: threshold, XXL: 8 bits lower than threshold, XXH: 8 bits higher than threshold; YY: the output Trigger value, YYL: Trigger value is 8 bits lower, YYH: Trigger value is 8 bits higher.]

#### **3.6.4 MATLAB Program**

##### **1) Generate the class TriggerBox.m**

The constructor of the TriggerBox class is TriggerBox(port, tcpPort), where the port is the port number of the TriggerBox, and the string type, such as 'COM3', can also be empty, which will automatically find the port number of the connected TriggerBox; tcpPort is an internal tcp port that needs to be used in some special cases, and is empty during normal use.

Initialize sensorID = 1, which indicates that it is triggered by the photocell.

##### **2) Set the trigger threshold**

Read the sensor parameters, the function of which is sensorPara = GetSensorPara(obj, sensorID), where obj is the class object and sensorID is 1, indicating that the photocell is triggered.

Modify the sensorPara.Threshold in sensorPara, and then set it to the sensor parameters. The function to set the sensor parameters is SetSensorPara(obj, sensorID, sensorPara), where obj is the class object; sensorID is 1, indicating that the photocell is triggered; sensorPara is the sensor parameter structure.

We recommend that you use the GetSensorSample(obj, sensorID) function to obtain the sampled value of the sensor and calculate the required threshold. obj is a class object; If the sensorID is 1, the photocell triggers.

##### **3) Output Trigger**

---

Since it is a type of photocell trigger, it is divided into 2 steps when outputting the trigger:

1 is to set the value of trigger, the function used is `SetEventData(obj, sensorID, eventData, triggerToBeOut)`, and `obj` is the class object; `sensorID` is 1, indicating that the photocell is triggered; The value of the Trigger output by `eventData`, ranging from 0 to 255 integers (uint8); `triggerToBeOut` defaults to 1.

2 is to bring the photocell to the set threshold, which is usually achieved by the `Screen` function of Psychtoolbox. After the photocell reaches the threshold, the `TriggerBox` will output the value set in the first step.

```
4) Use the sample
t=TriggerBox();
sensorID = 1;
sensorPara = t.GetSensorPara(sensorID);
Screen('DrawTexture',obj.winPtr,          obj.textureTrigger,
obj.triggerRect, obj.triggerRect, [], [], [], obj.winWhite);
Screen('Flip',obj.winPtr);
WaitSecs(0.1);
sensorWhite = t.GetSensorSample(sensorID);
Screen('DrawTexture',    obj.winPtr,    obj.textureTrigger,
obj.triggerRect, obj.triggerRect, [], [], [], obj.winBlack);
Screen('Flip',obj.winPtr);
WaitSecs(0.1);
sensorBlack = t.GetSensorSample(sensorID);
sensorPara.Threshold = 0.8*(sensorWhite - sensorBlack) +
sensorBlack;
t.SetSensorPara(sensorID, sensorPara);
```

---

```
    for i = 1:100
        t.SetEventData(sensorID, i);
        Screen('DrawTexture',    obj.winPtr,    obj.textureTrigger,
obj.triggerRect, obj.triggerRect, [], [], [], obj.winWhite);
        pause(1);
    end
    (Audio events are the same as light, just sensorID)
```

---

### 3.7. Multi-parameter TriggerIN/OUT device is used

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#### 3.7.1. Multi-parameter TriggerIN/OUT device connection

Multi-parameter TriggerIN/OUT devices support two connection modes, and different connection methods support different application scenarios.

Method 1: Connect directly to the multi-parameter synchronization box



Figure 13 The TriggerIN/OUT device is directly connected to the synchronization box

Note that in this case, the events generated by the TriggerIN/OUT device can be retrieved simultaneously by all experimenters (all multi-reference hosts) using the synchronization box for this experiment.



Method 2: Connect to an external event box, and connect the external event box to the multi-parameter synchronization box



Figure 14 The TriggerIN/OUT device connects to the synchronization box via a public event forwarder

Note that in this case, the events generated by TriggerIN/OUT can be retrieved simultaneously by all experimenters (all multi-reference hosts) using the synchronization box in this experiment.

3.7.2 Multi-parameter TriggerIN/OUT device is used

The use of the multi-parameter TriggerIN/OUT device depends on the multi-parameter synchronization box, and the TriggerIN/OUT device must be directly or indirectly connected to the multi-parameter synchronization box before use.

Trigger Box				
Module Name		Serial Number	IP	Use
TR_FFFFFFFF9	11/20	FFFFFFFF9	127.0.0.1	<input type="radio"/>

Figure 14 IP address of the synchronization box

In this case, you can use the multi-parameter TriggerIN/OUT device connected under the synchronization box in two ways, and these two

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methods can be used at the same time:

- (1) Access the multi-parameter TriggerIN/OUT device through the IP address and port 4321 of the synchronization box. In this case, you need to find the IP address of the synchronization box. For example, in the preceding figure, the IP address of the synchronization box is 192.168.31.103. You can use the TCP client to connect to port 4321 under this IP address, and after the connection is successful, you can use the device.
- (2) The synchronization box is connected to the PC through a serial port cable, and the multi-parameter TriggerIN/OUT device is accessed through the serial port generated on the PC (see the instructions for the synchronization box for details). Find the sequence number of the COM port corresponding to the synchronization box, and use the serial port parameter configuration (115200bps, data bit 8 bits, stop bit 1 bit, check bit none, no flow control) to establish a connection with the synchronization box.

Note: The multi-parameter TriggerIN/OUT device will be used as a TriggerIn device during the period when the TriggerOut is not output, and can be connected to the general-purpose TriggerOut device via an 8-bit analog signal (DB25 connector) to monitor the Trigger event output from the parallel port. If you want to use a multi-parameter TriggerIN/OUT device as a TriggerOut output device, see "Instructions for Instructions" in Section 3 for how to use it. During the output TriggerOut (the time when the physical interface output remains high), the multi-parameter TriggerIN/OUT device will not monitor the TriggerIn and will only be used for the TriggerOut output.

---

### 3.7.3 Command Description (TriggerOut Function)

#### 3.7.3.1 Instruction Description

The multi-parameter TriggerIN device communication protocol follows the DCP protocol format, i.e. (including the sending and receiving of commands):

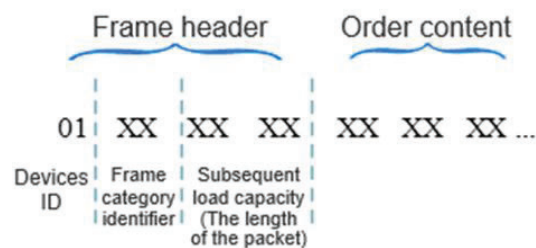


Figure 15 DCP Protocol Command Format

#### 3.7.3.2 Sets the high duration of the TriggerOut

✧ **Set the high duration of TriggerOut:**

**01 09 01 00 XX**

[Among them, XX: the high level duration of the output TriggerOut physical interface, in ms, the value range is 1~0xFF, and it will not be lost when the power is off.Default: 3ms]

The command reply is the same as the command:

**01 09 01 00 XX**

#### 3.7.3.3 Output the TriggerOut event

✧ **Output a single TriggerOut event:**

**01 E8 01 00 XX**

[Where, XX: the output Trigger value, specified by the user].

---

Note: A single output of a TriggerOut event will stop any ongoing looping output TriggerOut tasks!

The command reply is the same as the command:

**01 E8 01 00 XX**

✧ **Loop the output of the TriggerOut event (in seconds):**

**01 EA 03 00 01 AA BB**

[where AA: the output Trigger value, specified by the user; BB: the time interval between two consecutive TriggerOut events, in seconds.]

The command reply is the same as the command:

**01 EA 03 00 01 AA BB**

✧ **Stop the loop to output the TriggerOut event (in seconds):**

**01 EA 03 00 00 AA BB**

[where AA: the output Trigger value, specified by the user; BB: the time interval between two consecutive TriggerOut events, in seconds.]

Command replies are the same as commands

**01 EA 03 00 00 AA BB**

✧ **Loop the output of the TriggerOut event (in milliseconds):**

**01 EB 04 00 01 AA BL BH**

[where AA: the output Trigger value, specified by the user; B: The time interval between two consecutive TriggerOut events, in milliseconds, BL is the lower 8 bits of the time interval, and BH is the upper 8 bits of the time interval.]

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The command reply is the same as the command:

**01 EB 04 00 01 AA BL BH**

✧ **Stop looping out the TriggerOut event (in milliseconds):**

**01 EB 04 00 00 AA BL BH**

[where AA: the output Trigger value, specified by the user; B: The time interval between two consecutive TriggerOut events, in milliseconds, BL is the lower 8 bits of the time interval, and BH is the upper 8 bits of the time interval.

The command reply is the same as the command:

**01 EB 04 00 00 AA BL BH**

## 4. Fault analysis and troubleshooting

Fault phenomenon	Possible causes	Exclusion Method
<b>The network access indicator is not on</b>	The indicator light is damaged	Return to the factory for overhaul
	The serial cable is damaged	You can use the power supply to connect with the network cable first; The serial port line is returned to the factory for maintenance
<b>The indicator light is on normally, and there is no mark of the corresponding synchronization signal</b>	Enter a different CIDR block	1) Use the router management interface to check whether there is a TriggerBox in the network segment 2) View the txt-SSID in the TriggerBox SD card (3.3.6) 3) Plug and unplug the TriggerBox
	The device is damaged	Replacement of equipment and accessories

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## 5. Equipment maintenance

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### Warning

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- The maintenance of this equipment must be carried out by experienced professionals.
  - Under effective and reasonable maintenance conditions, the service life of the equipment is 8 years.
- 

Regularly (it is recommended to wipe the plastic part of the multimodal device TriggerBox and accessories with a clean, soft, slightly damp cloth on a weekly basis or as necessary).

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## 6. Repair details

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### Attention!

Brightcom will not be responsible for the safety and effectiveness of this device if:

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- Assemble, expand, readjust, improve and repair the equipment by persons not approved by Brightcom;
  - Personnel who have not received professional technical training are responsible for the operation, maintenance and storage of this equipment;
  - The operator fails to perform the operation in accordance with the operating specifications specified in this manual;
  - Connect to this device using accessories or external devices that have not been approved by Brightcom.
- 

### 6.1. Warranty

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The warranty period of the hardware system of this equipment is 1 year, and if there is a quality problem within 1 year from the date of sale, we will be responsible for solving all aspects of the problem, such as repair materials and equipment performance. The warranty period of the equipment will not be extended by purchasing other parts and accessories from the company. Changes in the service, technology or performance of the product by others without the prior permission of the company or its authorized agents may void this warranty.

The 1-year warranty period is a commitment under normal use of the equipment, and this commitment does not apply to the following situations:



- 
- ✧ Damage caused by the crushing of other objects, the dumping of equipment, the spillage or immersion of liquids;
  - ✧ Damage caused by fire, flood, hurricane, earthquake or lightning;
  - ✧ Neuracle's original number, label or manufacturing mark is replaced or torn off;
  - ✧ Damage caused by an inappropriate operating environment;
  - ✧ Damage caused by connections and operations to the hardware system beyond the design;
  - ✧ Damage caused by unauthorized erroneous maintenance and overhaul;
  - ✧ Damage caused by incorrect power connections;
  - ✧ Damage caused by misuse and abuse in violation of operational procedures;

## 6.2. Repair contact information

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If it needs to be repaired or replaced, the user can contact the user service department by telephone, email, etc., and inform the product model and number (which has been marked in the label and packing list); In addition, the accompanying product must be accompanied by a fault description, and the device will be shipped to Neuracle or its authorized agent after approval by the user service department, and the user needs to bear the shipping cost (including customs fees).

Neuracle maintenance contact information:

<b>Address</b>	10# 202, 2nd Floor, 10# Factory, Changzhou Science and Education City Intelligent Industrial Park, No. 18, Changwu Middle Road, Wujin District, Changzhou City, Jiangsu Province
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<b>Zip code</b>	213164
<b>Tel</b>	+86 519 8100 1682
<b>Fax</b>	+86 519 8100 1682
<b>Address</b>	<a href="mailto:info@neuracle.cn">info@neuracle.cn</a>

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## 7. Transportation and storage

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### 7.1. Disassembly

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#### Attention !

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- When transporting or storing the equipment for a long time, all parts must be placed in the special equipment box that comes with it as required or repacked properly.
- 

### 7.2. Transportation

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It can be transported by general means of transport, and the environmental conditions of transportation are the same as those of storage.

#### Attention !

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- It shall not be mixed with toxic, harmful and corrosive substances during transportation.
  - Severe vibrations and collisions should be avoided during transportation.
  - The equipment should be moisture-proof, dust-proof and inverted during transportation.
- 

### 7.3. Storage

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Store the boxed equipment on a stable floor or countertop. The environmental requirements for storage or transportation are as follows:

- ✧ Temperature: -20°C~55°C
- ✧ Relative humidity: ≤90%
- ✧ Atmospheric pressure: 700hPa~1060hPa
- ✧ The warehouse should be well ventilated and free of corrosive gases

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## 8. Disposal

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According to the corresponding national laws and regulations, the end-of-life electronic equipment should be disposed of, and the end-of-life multimodal equipment TriggerBox should be packaged with cardboard and protective plastic and sent to a recycling institution, which should be able to handle materials such as printed circuit boards, wires and cables, plastics and metal parts.

### **Attention !**

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-  The product bears this mark, please comply with the relevant provisions of the

Waste Electrical and Electronic Equipment Directive (WEEE), and the product shall not be disposed of as household waste.

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## 9. Statement

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### 9.1. FCC Statement

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Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

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 turning 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/TV technician for help.

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## 9.2. ISED Statement

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This equipment complies with ISED radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Le rayonnement de la classe B respecte ISED fixaient un environnement non contrôlés. Installation et mise en œuvre de ce matériel devrait avec échangeur distance minimale entre 20 cm ton corps. Lanceurs ou ne peuvent pas coexister cette antenne ou capteurs avec d'autres.

This device complies with Innovation, Science and Economic Development Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

- (1) this device may not cause interference, and
- (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'ISED applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.



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