SKX-1000E

SPO2 Simulator

Operation manual

Version: V 2.1

Xuzhou Mingsheng electronic Technology Co., LTD

Catalogue

Chapter 1 SKX-1000E instrument features and functions

SKX-1000E SPO2 Simulator is a signal simulation tool for the development and detection of blood oxygen saturation products developed by Xuzhou Mingsheng Company.Because it can produce different curves, different pulse amplitude of the analog optical signal, is the necessary first choice for the development of measurement of blood oxygen products, it has a wide range of signal amplitude, can simulate a variety of intensity, frequency of blood oxygen signals, is an important tool for the development of measurement of blood oxygen products.The simulator also has the function of detecting blood oxygen measurement products, and is used to test whether the parameters of blood oxygen products can meet the requirements of national standards. The following chapters will describe the Settings during the detection process in detail.

Features are as follows:

1, built-in single 18650 large capacity lithium battery, power management module, in the use of the process to ensure stable power supply, low interference output; When the voltage is lower than 3.6V, the digital tube flashes, indicating low power; External 4.2V DC power charger.

2, External analog finger for easy connection to any blood oxygen detector.

3, Using the key to operate, you can directly change each data bit of the parameter, parameter change is simple, convenient, fast, convenient for users to set.

4, The 4-digit digital tube is used to display parameter items, such as blood oxygen saturation value, pulse rate value, signal strength, curve selection and other parameters.

5, The simulator is a transmission type blood oxygen optical simulator.

6, You can set the periodic automatic adjustment of blood oxygen saturation and pulse rate, and the automatic adjustment period can be set. When the period is set to zero, it means manual adjustment; It is used to customize the value change during production aging.

7, 10 universal ECG connector, can easily connect ECG products.

8, 12 leads synchronous ECG signal output, output different 12-lead ECG waveform.

9, contains 8 kinds of ECG waveform.

Blood oxygen part performance introduction:

- External analog finger, can be easily connected to any blood oxygen test instrument;
- It is a transmission type multi-functional optical analog instrument, built-in commonly used BCI, Nellcor, Minary, Masimo four waveform curves;

- Blood oxygen saturation simulation range:

  80%, 85%, 90%, 98%, 4-point numerical detection and calibration, error ≤1%;

  60%, 65%, 70%, 75%, 4-point numerical detection and calibration, error ≤2%;

- Pulse rate simulation range:

  30bpm, 60bpm, 80bpm, 100bpm, 120bpm, 160bpm, 180bpm, 240bpm, a total of 8 test points, error ≤1bpm;

- Pulse intensity range:

  1%, 2%, 4%, 5%, 10%, 20%.

Note: Most of the blood oxygen products commonly produced by large manufacturers on the market use NELLCOR curve, a small number of BCI, Mindray series products please choose the corresponding Minary curve; Brand Monitor If the instrument is marked with the MASIMO logo, use the corresponding MASIMO curve. Since the product database does not necessarily cover all instruments at home and abroad, the blood oxygen of some instruments may not be detected or the detection value is different. Welcome to feedback to our company for product improvement and upgrading!

ECG part performance introduction:

- Normal ECG waveform, can output different amplitude and type of 12-channel synchronous waveform, I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6;
- Heart rate detection waveform in positive and negative directions for detecting heart rate range;
- Square wave, using square wave to measure scanning speed;
- Sine wave, measuring amplitude-frequency characteristics;
- It can change the T-wave amplitude, heart rate value, R wave amplitude, R wave width of the simulation QRS waveform, by changing the width of the R wave to simulate the ECG waveform of adults or children or newborns;
- The respiratory waveform is output through the RA-LL standard II lead, the baseline impedance is fixed at 1K, and the impedance change is about 2Ω impedance respiratory waveform, and the value of respiratory rate can be changed;
- ECG waveform signal amplitude can be set;
- The pulse pacing signal with continuously adjustable pulse width is used to detect the pulse pacing ability of the ECG.

Chapter 2 Precautions for SKX-1000E instrument use

1, Because the blood oxygen saturation detection needs to correspond to optical signals, when using this simulator, please try to avoid detection under strong light, which may cause numerical deviation, especially when digital blood oxygen detection, you can use some shading facilities to block light when necessary;

2, the analog finger of the analog instrument has positive and negative (or up and down) direction, only and must be in the correct direction of the premise, in order to carry out normal work;

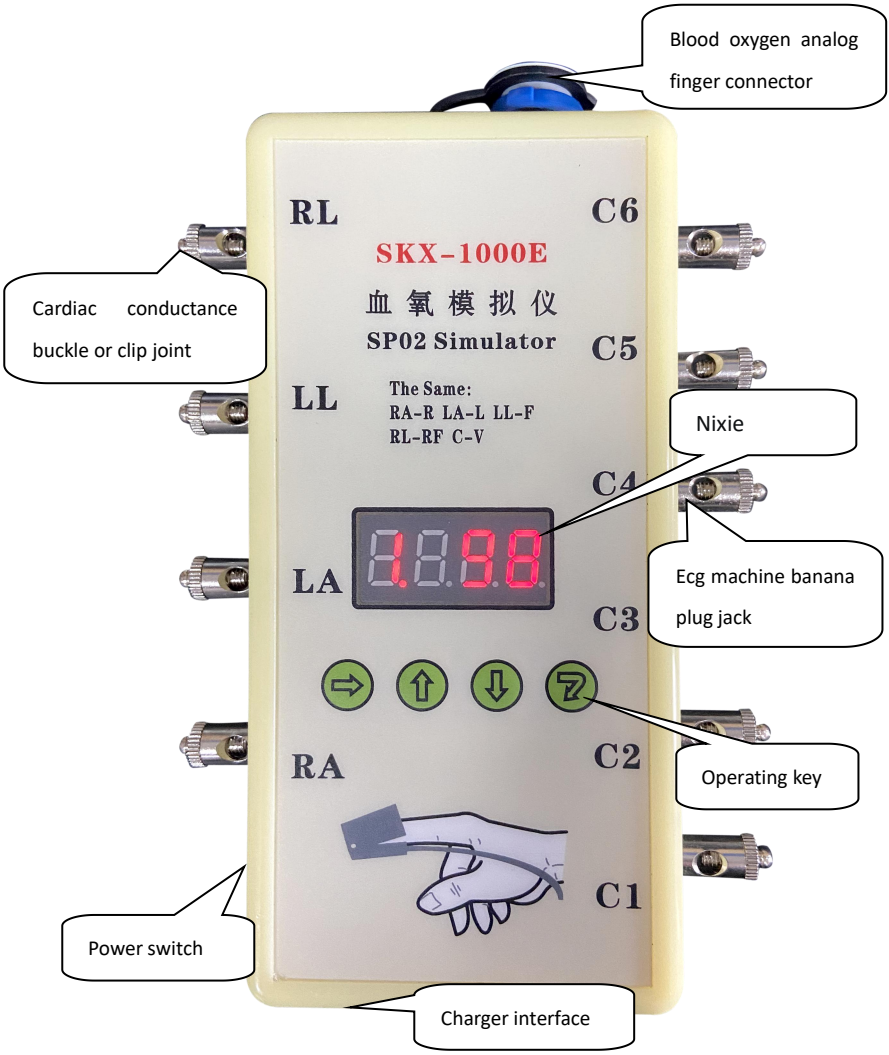
3, When the simulator is working, if the charger is connected, it may increase the power frequency interference of the ECG waveform, under normal circumstances, the ECG module part of the instrument will filter this part of the interference, the interference of the respiratory waveform may be larger, will produce and superimpose the sine wave signal, the simulated waveform of blood oxygen saturation will also cause waveform overlap frequency interference;

4, When the digital tube flashes, it means that the built-in battery voltage is lower than 3.6V, then please note that the amplitude of the ECG waveform will be reduced; In this state, please charge as soon as possible, so as not to affect normal use;

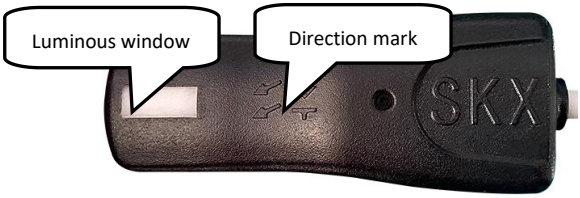
5, After the simulator is powered on, it automatically generates a blood oxygen saturation value of 98%, pulse rate of 80bpm, blood oxygen parameter data and code of NELLCOR curve are normal ECG waveform of 6, and respiratory waveform of 15bpm;

6, When using NELLCOR or Mindray Curve, you must choose a 660nm/905nm blood oxygen probe for easy consistency with clinical data. When using BCI curves, use a 660nm/940nm blood oxygen probe for easy consistency with clinical data. When selecting the MASIMO curve, use the MASIMO original probe.

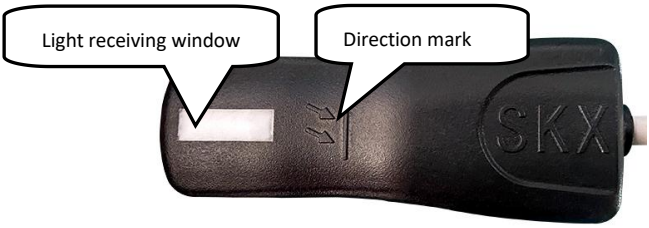
Chapter 3 SKX-1000E instrument connection description



Connection of blood oxygen probe to simulated finger:



Place this side of the simulated finger (shown above) on the receiving tube end of the blood oxygen probe



Place this side of the simulated finger (shown above) on the red tube end of the blood oxygen probe

1. The part marked with on the blood oxygen simulation finger, please point to the light-emitting tube part of the blood oxygen probe; Please point the part marked with on the finger of the blood oxygen simulator at the receiving tube part of the blood oxygen probe. At the same time, be sure to note that the white window position on the finger should be aligned with the receiving tube position, otherwise the effective value may not be obtained.

2. When the blood oxygen probe is empty, the red light of the blood oxygen probe is blinking. When the simulated finger is placed in the blood oxygen probe, if it enters the normal working state, the red light of the blood oxygen probe is steady on.

3. In the process of detecting blood oxygen saturation, if there is a certain deviation in the blood oxygen value, you can check whether the value is corrected by repeatedly placing the analog finger.

Connection of the electrocardiogram:

1, Electrocardiogram machine connection: RA-R(right hand), LA-L (left hand), LL-F (left leg), RL-RF (N) (right leg), C1-C6 thoracic guide;

2, Monitor connection: RA- right hand (white), LA- left hand (black), LL- left foot (red), RL- right foot (green), C1-C6 chest guide (brown);

3, Three connections: RA- right hand (white), LA- left hand (black), LL- left foot (red);

4, European standard connection method: L-LA R-RA RF(N)-RL F-LL C-V;

5, The default II lead amplitude is 1mV when the analog device is turned on. In the heart rate detection waveform, square wave, sine wave and QRS wave, the amplitude of the II lead is 1mV.

Chapter 4 Describes the SKX-1000E display contents

This simulator uses 4 digital tubes for display, each of which represents a different content, which will be described in detail below.

As shown in the figure above (1.98), there are four digital tubes from left to right, corresponding to the following contents:

1. The number 1 of the first digital tube is the menu item of waveform code, which represents the type of waveform issued by the current analog instrument. The specific type of waveform code is listed in the following table

Waveform code	Representative waveform
1	Blood oxygen saturation
2	Pulse rate value
3	Curve selection
4	Pulse intensity AMP
5	The value of blood oxygen saturation and pulse rate automatically adjusts the cycle
6	Normal ECG waveform
7	Heart rate detection waveform in positive and negative directions
8	Square wave
9	Sinusoidal waveform

A	Simulate QRS-T waveform
b	Respiratory waveform that can change respiratory rate + ECG waveform that fixed heart rate
C	Set the amplitude of the waveform, affecting the waveform 7,8,9, d, E
d(extended)	Ecg waveform with pre-pacing signal can change the heart rate and pacing pulse
E(extended)	Pacing pulse signals in positive and negative directions

2. The second, third, and fourth digital tubes are numerical values representing specific parameters in the corresponding waveform menu item (corresponding to the hundreds, tens, and ones of the parameters, respectively).

For example:

When the value is 1.60, the current waveform is the blood oxygen waveform, and the blood oxygen value is 60%

When it is displayed as 1.98, the current waveform is the blood oxygen waveform, and the blood oxygen value is 98%

When it is displayed as 2.80, the current waveform is the blood oxygen waveform and the pulse rate value is 80bpm

When it is displayed as 6.60, the current waveform is the ECG waveform and the heart rate value is 60bpm

When the display is 7.75, the current waveform is the heart rate detection waveform, and the heart rate value is 75bpm

When it is displayed as 8.10, the current waveform is a square wave, and the frequency of the square wave is 1Hz

When 9.10 is displayed, the current waveform is a sinusoidal waveform, and the frequency of the waveform is 10Hz

When it is displayed as A.20, the current waveform is the QRS-T waveform, and the amplitude of the T-wave is 0.2mV

When it is displayed as b.15, the current waveform is a respiratory wave, and the respiratory rate value is 15 times/min

When displayed as C.100, the amplitude of the current waveform is 1mV

When it is displayed as d.30, the current waveform contains the ECG waveform of the pre-pacing signal, the pre-pacing pulse width is 30mS, and the heart rate value is 75bpm

When it is displayed as E.20, the current waveform is a pacemaker pulse signal with a pulse width of 2mS

Chapter 5 SKX-1000E key description

There are four keys in this simulator, as shown in the figure below, they are shift select key, value increase key, value decrease key and confirm change key; The following describes the functions of the four buttons in detail.

As shown in the figure above, the current display content of the digital tube is 1.98, and there is a red decimal point in the lower right corner of the digital tube of the number 1, which represents the current number as the changeable item of the menu option;

Shift selection key: This key is used to select the content you want to change. If you want to change the type of waveform, please use this key to move the red decimal point to the first digit tube.

Value increment key: increase the numeric bit of the current change item;

Value reduction key: Reduce the value bit of the current change item;

Confirm change key: After the current change item is changed, please select this button to confirm the change;

For example, if the current display content is 1.98, you need to change the waveform type to normal ECG waveform and change the heart rate to 178.

The following operation process is followed (general process) :

1, Use the shift select key to shift the red decimal point to the bottom right corner of the first digit tube (if it was originally here, omit this step);

2, Select the value increase key to change the display content of the first digit tube to 6;

3, Press the Confirm change key, then the display content of the digital tube is changed to 6.60, indicating that the current waveform has been changed to normal ECG waveform, and the current heart rate is 60bpm;

4, Using the shift selector key, move the red decimal point to the second digit tube (in the hundreds place of the value);

5, Select the value increase key, the second digital tube display content is 1;

6, Continue to use the shift select key to move the red decimal point to the third digit tube (the tenth of the value);

7, Select the value increase key, the third digit digital tube display content is 7;

8, Continue to use the shift select key to move the red decimal point to the fourth digit tube (the units of the value);

9, Select the value increase key, the fourth digit digital tube display content is 8, the current heart rate value is changed;

10, Finally, please select the Confirm change button to confirm the changed content. At this time, the waveform emitted by the simulator is a normal ECG waveform (waveform code 6), and the heart rate is 178bpm. Single change complete.

How to use the key combination:

In the waveform code A simulating QRS-T waveform, it is necessary to use the combination of keys to change the content of each parameter, the operation process is described in detail below:

1, first according to the above general process to change the waveform to code A (analog QRS-T wave), at this time the digital display content is 10, indicating that the amplitude of T wave is 0.1mV;

2, To use a key combination, follow the procedure below to operate the keys to use the key combination;

3, First, press the Confirm change key while holding down the shift selection key;

4, Then release the confirm change key;

5, Then release the shift selection key;

6, Press the Confirm button twice again;

7, the numeric display content of the digital tube changes to 75, indicating that the current R-wave frequency is 75bpm; Then use the key combination, the display content is updated to 100, indicating that the current amplitude is 1mV; Then using the key combination, the display content is updated to 80, indicating that the bottom width of the R wave is 80ms; The above parameter options can be changed sequentially using key combinations.

Chapter 6 Describes SKX-1000E parameter performance

The following describes the waveform parameter content and setting range of waveform code 1-E

1, blood oxygen saturation value:

★The blood oxygen value is set up in a total of 8 grades, which are 98%, 90%, 85%, 80%, 75%, 70%, 65%, 60%; Initial value: 98%;

★The blood oxygen value can be directly selected and set through the key of value increase and value decrease, and there is no need to change the key by confirming.

2, pulse rate value:

★The pulse rate value is set in a total of 8 levels, which are 30bpm, 60bpm, 80bpm, 100bpm, 120bpm, 160bpm, 180bpm and 240bpm.

★Error ≤1bpm;

★The initial value is 80bpm, and the blood oxygen value can be directly selected and set by the key of value increase and value decrease, and there is no need to change the key by confirming.

3, Curve selection: At present, a total of 4 curves are supported, respectively

★Curve 1 is the BCI curve;

★Curve 2 is NELLCOR;

★Curve 3 is Mindray curve;

★Curve 4 is the MASIMO curve.

4. Pulse intensity (AMP)

★Amplitude value: 20%, 10%, 5%, 4%, 2%, 1%, initial value 10%.

5, the value automatically changes the time cycle

★0 indicates that the value is changed manually;

★The value ranges from 1 to 60. The unit is minute;

★When the value is set to automatic change, the value of blood

oxygen saturation and pulse rate are changed in turn according to the set automatic cycle, and a total of 8 groups of data are changed in turn.

6, normal ECG waveform:

★ Heart rate setting range: 10-250bpm, initial value: 80bpm;

★ In this waveform option, the waveform signal amplitude of each lead is fixed.

7, positive and negative heart rate detection waveform:

★ Frequency range: 10-400bpm, initial value: 75bpm;

★ Amplitude range: 0.1-4mV;

★ The two modes are positive waveform and negative waveform. Select by key combination.

8, Square Wave:

★ Frequency range: 0.1Hz-10Hz, initial value: 10 (1Hz);

★ Amplitude range: 0.1-4mV.

9, Sinusoidal waveform:

★ Frequency range: 1-100Hz, initial value: 25 Hz;

★ Amplitude range: 0.1-4mV.

A, Simulate QRS-T waveform

★ This waveform has four operating modes

Mode 1: The amplitude of T wave can be changed;

Mode 2: Set waveform frequency (heart rate);

Mode 3: Set the amplitude of QRS waveform (R-wave amplitude);

Mode 4: Set the width of QRS waveform;

The working modes are converted by the combination of keys;

★ T-wave amplitude setting range: 0.01mV-2mV, initial value: 20 (10:0.1mV);

★ Waveform frequency setting range: 20bpm-300bpm, initial value: 75bpm;

★ QRS waveform amplitude range: 0.1mV-2mV, initial value: 100

(1mV);

★ QRS Waveform width range: 10ms-150ms, initial value: 80ms.

B, Simulated breathing waveform:

★ Frequency range: 10-100 times/min, initial value: 15bpm;

★ Note that the respiratory lead is RA-LL and the baseline impedance is 1K. If the respiratory lead of the monitor is another lead, set the respiratory lead of the monitor to RA-LL or change the corresponding lead connection mode.

C, Signal amplitude setting:

★ Amplitude range: 0.1mV-4mV, initial value: 100 represents 1mV;

★ Please note that this amplitude setting will affect the waveform amplitude of 7, 8, 9, D, E.

D, Analog QRS waveform of pre-pacing signal

★ Mode 1: ECG signal of forward pacemaker pulse;

★ Mode 2: pre-negative pulse ECG signal, through the combination of keys to select;

★ Pulse waveform width: 1ms-30ms; (Initial value: 30), the rising edge is less than 300us;

★ Heart rate range: 20bpm-250bpm; (Initial value: 80bpm);

★ Pulse waveform width adjustment affects the pulse waveform under two modes;

★ The amplitude of the pulse waveform is set by the signal amplitude of code C.

E, Pacing pulse signals in positive and negative directions

★ Mode 1: forward pacing pulse;

★ Mode 2: negative pulse, selected by key combination;

★ Pulse waveform width: 1 (0.1ms) -20 (2ms), rising edge less than 300us;

★ Heart rate fixed at 60bpm;

★ The amplitude of the pulse waveform is set by the signal amplitude of code C.

Chapter 7 SKX-1000E after-sales service

***** The company will provide you with an 18-month warranty from the date of purchase of the instrument (battery, charger warranty for one year), the warranty expires, responsible for lifelong maintenance, and charge maintenance materials as required.

*** Our company will not provide free warranty service for the following reasons:**

▪ Failure caused by disassembly and modification of the product without authorization.
▪ Analog finger damaged by external damage, no warranty is provided.
▪ Failure caused by careless falls and drops in the process of use and handling.
▪ Failure due to lack of proper maintenance and failure to meet environmental requirements.
▪ Failure caused by not following the correct instructions in the operating manual.
▪ Failure caused by self-repair without our company's permission.
▪Failure caused by the irresistible forces of nature caused by natural disasters, fires, earthquakes, etc.

* If you need warranty service, please contact our technical service center directly in the form of telephone, letter, fax, etc., such as contact with other personnel or departments, there may be information transmission interruption, resulting in misunderstanding of time and service, the most important thing is to affect your normal use.

* After-sales service information:
▪ Full name: Xuzhou Mingsheng Electronic Technology Co., LTD
▪ Address: 726, Block A, Shimao Diamond International, Yunlong District, Xuzhou City
▪ ZIP Code: 221004
▪ Tel: 0516-83460606, 83469046
▪ Chuanzhen: 0516-83469046
▪ E-mail: xzFRD@163.com
▪ Company website: WWW.XZMSDZ.COM

Appendix 1

Weak perfusion characteristics of blood oxygen

Because the performance of digital oximetry mainly depends on the precision of digital probe, the performance of its receiving tube directly determines the weak perfusion performance of digital oximetry. Relative to the traditional analog signal method to get blood oxygen saturation, in a certain degree of weak perfusion, such as more than 1%, the performance of the digital probe is stronger than the analog probe, can improve anti-interference, mainly in no matter anyone's fingers thick or thin, children or newborns can get a good performance. When simulating blood oxygen in extreme fields such as newborn or children's fingers, if the fingers are very thin, the light transmittance of the fingers is too strong, which may cause misjudgment of the probe falling off detection. If the misjudgment is not caused, because the light transmission is too strong, it will lead to the front-end amplification part of the pulse detection circuit can not be simulated amplification, (because amplification will cause loss of pulse amplifier saturation state), so the waveform amplification function will be lost. In addition, because of the high light transmission intensity, although through adjusting the luminescence intensity of the luminescence tube, the received light intensity is still very strong. Therefore, in this state, the performance of analog blood oxygen is inferior to that of digital blood oxygen.

1. The digital oxygen receiving circuit has no limit on the light transmission intensity of the finger, so it improves the anti-interference ability in use and is suitable for a variety of people. However, the digital

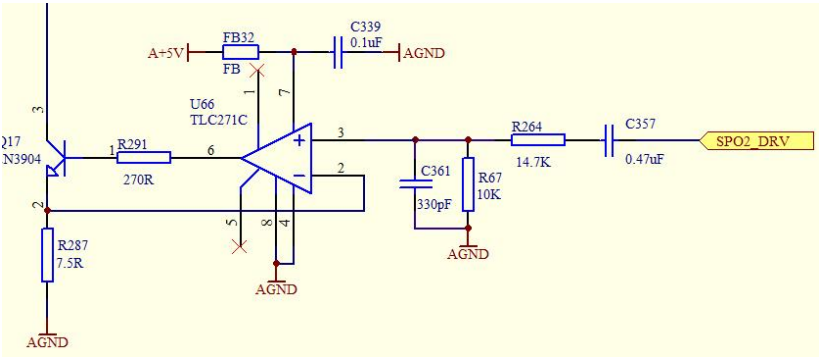
receiving tube has the potential to cause AC signal saturation after too strong DC signal. When the DC component is too large, it will cause the AC signal to work in an irregular interval, so it is suggested that the digital reception should come with luminous brightness adjustment, for the digital receiving tube work in a most reasonable space.

2.because the weak perfusion performance of digital blood oxygen completely depends on the performance of the receiving tube, so for a certain digital receiving tube, its weak perfusion performance is also determined, restricting the weak perfusion can not be further improved, after testing its weak perfusion performance can only be around 1%, can not be further improved.

3. Because the analog probe uses multistage signal amplification, for example, the pulse signal can be amplified and reduced through the adjustment of luminous intensity first, the pulse signal can be amplified by amplifying the pulse carrier signal, and finally the pulse signal can be amplified by high-precision AD and other ways to collect the pulse signal. Through the above three ways, the weak perfusion performance of blood oxygen can be improved, far more than the weak perfusion performance of digital probe. However, the above method has special circumstances, such as newborns or children, because the finger is small and thin, will lead to the finger light intensity is very strong, may lead to the first two kinds of signal amplification part performance failure, if you can overcome the above problems, the weak perfusion performance of the analog probe is much stronger than the digital probe.

About the detection method of simulated blood oxygen

The diode drive part can adjust the current through the diode to change the luminous intensity through the analog quantity "SPO2_DRV"



Receiving tube part circuit

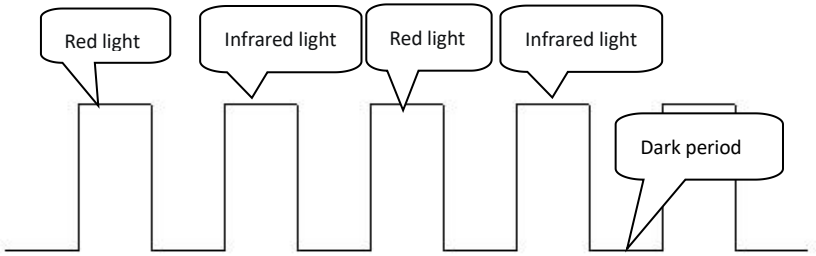
The waveform received by the differential amplification receiving tube is similar to the above luminous waveform, except that the blood oxygen waveform signal is already contained.

As the above waveform is similar, the blood oxygen waveform data has been contained, in this case, the waveform should be amplified according to the amplitude of the waveform, and finally enter the AD part of the CPU for direct acquisition, it is noted that there is no need to separate the above waveform, only need to be in the CPU program end according to the timing of the luminous part. It is OK to collect the waveform at the corresponding time point, and it is recommended that AD signals should be collected before closing and switching the light tube, so as to obtain effective data to the maximum extent.

The sequential circuit of the blood oxygen device driving the luminescent tube is shown below, with four modes:

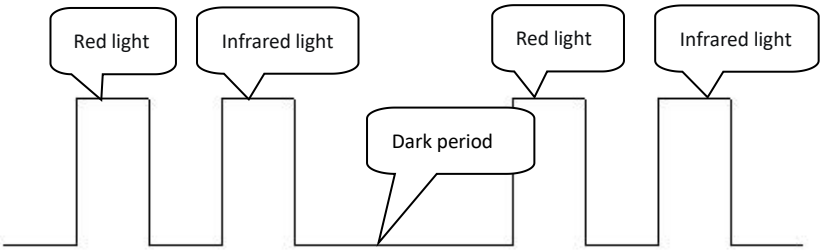
1, red light, infrared light alternating, the pulse period is the same, the dark period and the luminous period are equal.

The luminescence period can be set to 200us-1ms. The Dash series Nellcor module uses a 500us luminescence cycle



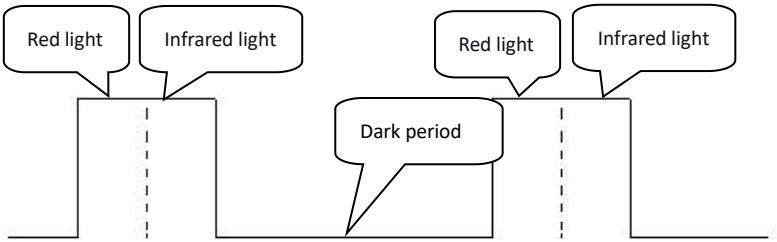
2, The timing of red and infrared light is fixed, as shown in the figure below:

The luminous order of red light and infrared light can be exchanged, but the cycle is the same cycle, the setting range is 200us-1ms, the dark period between red light and infrared light can be 200-1ms, and the fixed period between each group of luminous light can be customized according to demand, the default can be set to 8ms.



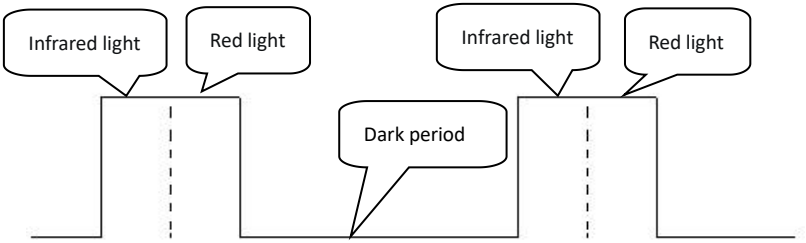
3, red and infrared light continuous light, no dark interval in the middle or dark interval is very small, less than 100us, as shown in the following figure:

In this case, the time interval of each group of luminous cycles is fixed, which can be defined as 8ms or other values



4, red and infrared light continuous light, no dark interval in the middle or dark interval is very small, less than 100us, as shown in the following figure:

In this case, the red and infrared light emission periods can be defined as 200us-1ms, and the time interval of each group of emission cycles is fixed, which can be defined as 8ms or other values



Please note:SKX-1000E blood oxygen simulator can detect the first three of the four cases. If the blood oxygen device is the fourth case of luminescence drive, please adjust the luminescence timing to meet the three cases.