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(54) **Transmit/Receive isolation for an ultrasound system**

Sende- bzw. Empfangsisolierung für ein Ultraschallsystem

Isolation de transmission/réception pour systèmes à ultrasons

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to ultrasound systems, and more particularly to transmit/receive isolation for an ultrasound system, with which a high voltage transmit signal is blocked from being propagated to a receiving unit during a transmission period as outlined in the claims.

BACKGROUND

[0002] Due to its non-invasive and non-destructive nature, an ultrasound system has been extensively used for acquiring internal information of a target object in the medical profession. Since the ultrasound system may provide a high resolution image to a doctor without a surgical treatment, which is performed by directly incising and observing the target object, it is very helpful in the medical profession.

[0003] Generally, an ultrasound system includes a transmit/receive switch. The transmit/receive switch connects a transmitting unit with an ultrasound probe during a transmission period of an ultrasound signal to transmit a high voltage transmit signal from a receiving unit to an ultrasound probe. At the same time, the transmit/receive switch blocks a transmit signal to be propagated to the receiving unit. The transmit/receive switch connects the receiving unit with the ultrasound probe during a receiving period of an ultrasound signal to transmit the receive signal outputted from the ultrasound probe, which receives the ultrasound signal reflected from a target object (i.e., ultrasound echo signal), to the receiving unit.

[0004] When an ultrasound image in thin depth is obtained with the conventional ultrasound system, a high voltage transmit signal is propagated to the receiving unit. This is because the transmit/receive switch cannot completely block the transmit signal to be propagated to the receiving unit. This not only affects the receiving unit but also reduces quality of the ultrasound image.

[0005] An ultrasound system according to the preamble of claim 1 is known from WO 06/61008 A1.

[0006] JP 2007 001463 A refers to an arc suppression system for a booster section and a method with easy maintenance capable of being constituted at low cost without using a switch such as an expensive thyristor with high insulation grade as in a conventional one, being not failed over a long period of time and capable of preventing generation of arc.

SUMMARY

[0007] Embodiments of an ultrasound system for blocking a high voltage transmit signal to be propagated to a receiving unit during a transmission period of an ultrasound signal are disclosed herein.

[0008] In one embodiment, an ultrasound system comprises the features as contained in claim 1.

[0009] In one embodiment, an ultrasound system comprises the features as contained in claim 3.

[0010] The Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended fo be used in determining the scope of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a block diagram showing an illustrative embodiment of an ultrasound system applied to a switching unit according to the present invention.

FIG. 2 is an illustrative a switching unit according to an embodiment of the present invention.

DETAILED DESCRIPTION

[0012] The present invention is described below in view of the provided drawings.

[0013] FIG. 1 is a block diagram showing an illustrative embodiment of an ultrasound system applied to a switching unit 140 according to the present invention. A transmitting unit 110 forms a high voltage transmit signal to obtain frames. The frames include B mode (brightness mode) image, D mode (Doppler mode) image, c mode (color mode) image, elasticity image, etc.

[0014] An ultrasound probe 120 converts transmit signals to a plurality of ultrasound signals, transmits them to a target object, receives a plurality of echo signals reflected from the target object and forms a plurality of receive signals based on the ultrasound echo signals. The ultrasound probe 120 includes a plurality of transducer elements for converting an ultrasound signal into an electronic signal and vice-versa.

[0015] A receiving unit 130 converts a plurality of receive signals from the ultrasound probe 120 to analog signals. In addition, the receiving unit 130 focuses a plurality of receive signals, which are converted in digital, based on a focusing point and position of a transducer element on the ultrasound probe 120. The receiving unit 130 forms a plurality of ultrasound data by using the plurality of receive and focusing signals.

[0016] A switching unit 140 is coupled to the transmitting unit 110, the ultrasound probe 120 and the receiving unit 130. The switching unit 140 connects the transmitting unit 110 to the ultrasound probe 120 during a transmission period of an ultrasound signal and transmits a high voltage transmit signal from the transmitting unit 110 to the ultrasound probe 120. At the same time, the switching unit 140 blocks the transmit signal to be propagated to the receiving unit 130. Also, the switch unit 140 connects the receiving unit 130 with the ultrasound probe 120 dur-

ing a receiving period of an ultrasound signal and transmits the receive signal from the ultrasound probe 120 to the receiving unit 130.

[0017] Now referring to Fig. 2, the switching unit 140 is described for isolating the receiving unit 130 from transmit signal during the transmission period of the ultrasound signal. In one embodiment, the switching unit 140 comprises a plurality of diode bridges, each being switchable between first and second states such that the respective transmit signal is blocked from being propagated to the receiving unit 130 when the diode bridge is in the first state and the respective receive signal is allowed to be propagated to the receiving unit 130 when the diode bridge is in the second state. The switching unit 140 further comprises a switching module 240 connected to the diode bridges. The switching module 240 is operable to reverse-bias the diode bridge in the first state and forward-bias the diode bridge in the second state. In one embodiment, the switching module 240 comprises a pair of switches. During the transmission period of an ultrasound signal, a first switch SW 1 is connected to a minus voltage terminal -V and a second switch SW 2 is connected to a plus voltage terminal +V, to make the diode bridge off. Thus, a high voltage signal from the transmitting unit 110 may not be propagated to the receiving unit 130 and the receiving unit 130 can be completely isolated. On the other hand, during the receiving period of an ultrasound signal, the first switch SW 1 is connected to the plus voltage terminal +V and the second switch SW 2 is connected to a minus voltage terminal-V Thus, the diode bridge is on and forward bias current may be propagated to the diode bridge. As such, the receive signal from the ultrasound probe 120 is transmitted to the receiving unit 130 via the diode bridge. The first and second switches can be implemented with mechanical relay transistors, field effect transistors (FET), etc. The switching module 240 is configured to control the diode bridges to be individually or simultaneously switchable.

[0018] Now referring Fig. 1, the control unit 150 controls the switching unit 140. Also, the control unit 150 controls transmit/receive of an ultrasound signal, as well as the formation and display of ultrasound images. The control unit 150 is responsive to a blocking instruction to control the switching unit to block the corresponding transmit signal from being propagated to the receiving unit, the control unit is further responsive to a non-blocking instruction to control the switching unit to allow the corresponding receive signal to be propagated to the receiving unit.

[0019] A processor 160 forms ultrasound images by using a plurality of ultrasound data from the receiving unit 130. A display unit 170 displays ultrasound images formed in the processor 160.

[0020] In one embodiment, an ultrasound system may include a voltage measuring unit. The voltage measuring unit may measure voltage of each of transmit signals during a transmission period of ultrasound signals and form a measured voltage. The control unit 150 may be operable to perform the following steps: comparing the measured voltage with a predetermined threshold voltage, controlling the switching unit 140 to block the respective transmit signal from being propagated to the receiving unit 130 if the measured voltage is over the predetermined threshold voltage, controlling the switching unit 140 to allow the respective receive signal to be propagated to the receiving unit 130 if the measured voltage is below the threshold voltage.

Claims

1. An ultrasound system (100), comprising:

a transmitting unit (110) configured to form a plurality of transmit signals;
an ultrasound probe (120) configured to convert the transmit signals to a plurality of ultrasound signals, transmit the ultrasound signals to a target object, receive a plurality of echo signals reflected from the target object and form a plurality of receive signals based on the echo signals; and
a receiving unit (130);
characterized by comprising:

a switching unit (140) coupled to the transmitting unit (110), the ultrasound probe (120) and the receiving unit (130) and comprising a plurality of diode bridges each being switchable between first and second states such that the respective transmit signal is blocked from being propagated to the receiving unit (130) when the diode bridge is in the first state and the respective receive signal is allowed to be propagated to the receiving unit (130) when the diode bridge is in the second state,
wherein the switching unit (130) further comprises a switching module (240) comprising a plurality of pairs of switches (SW1, SW2) connected to the respective diode bridges, wherein each pair of switches (SW1, SW2) is configured to perform switching between a plus voltage and a minus voltage to forward-bias the respective diode bridges in the second state and to reverse-bias the respective diode bridges in the first state.

2. The ultrasound system (100) of Claim 1, wherein the switching module (240) is configured to control the diode bridges to be individually or simultaneously switchable.

3. An ultrasound system (100), comprising:

a transmitting unit (110) configured to form a plurality of transmit signals;
an ultrasound probe (120) configured to convert the transmit signals to a plurality of ultrasound signals, transmit the ultrasound signals to a target object, receive a plurality of echo signals reflected from the target object and form a plurality of receive signals based on the echo signals; and
a receiving unit (130),
characterized by comprising:

a switching unit (140) coupled to the transmitting unit (110), the ultrasound probe (120) and the receiving unit (130) and comprising a switching module (240) comprising a plurality of pairs of switches (SW1, SW2) connected to the respective diode bridges, wherein each pair of switches (SW1, SW2) is configured to perform switching between a plus voltage and a minus voltage; and
a voltage measuring unit configured to measure a voltage of each of the transmit signals to form a measured voltage;

a control unit (150) configured to perform the following steps:

comparing the measured voltage with a predetermined threshold voltage,
controlling the switching module (240) for reverse-biasing of the diode bridges to block the transmit signal from being propagated to the receiving unit if the measured voltage is over the predetermined threshold voltage, and
controlling the switching module (240) for forward-biasing of the diode brides to allow the receive signal to be propagated to the receiving unit if the measured voltage is below the predetermined threshold voltage.

Patentansprüche

1. Ultraschallsystem (100), welches Folgendes aufweist:

eine Übertragungseinheit (110), die dafür vorgesehen ist, eine Vielzahl von Übertragungssignalen zu bilden;
eine Ultraschallsonde (120), die dafür vorgesehen ist, die Übertragungssignale in eine Vielzahl von Ultraschallsignalen zu konvertieren, die Ultraschallsignale zu einem Zielobjekt zu übertragen, eine Vielzahl von von dem Zielobjekt reflektierten Echosignalen zu empfangen und eine Vielzahl von auf den Echosignalen basierenden Empfangssignalen zu bilden; und
eine Empfangseinheit (130);
gekennzeichnet durch
eine Umschalteinheit (140), die mit der Übertragungseinheit (110), der Ultraschallsonde (120) und der Empfangseinheit (130) verbunden ist und eine Vielzahl von Diodenbrücken aufweist, die jeweils zwischen ersten und zweiten Zuständen so umschaltbar sind, dass das jeweilige Übertragungssignal daran gehindert wird, zu der Empfangseinheit (130) übertragen zu werden, wenn sich die Diodenbrücke in dem ersten Zustand befindet, und dass es dem entsprechenden Empfangssignal ermöglicht wird, zu der Empfangseinheit (130) übertragen zu werden, wenn sich die Diodenbrücke in dem zweiten Zustand befindet;
wobei die Umschalteinheit (140) des Weiteren ein Umschaltmodul (240) aufweist, welches eine Vielzahl von Schalterpaaren (SW1, SW2) aufweist, die mit den jeweiligen Diodenbrücken verbunden sind, wobei jedes Schalterpaar (SW1, SW2) dafür vorgesehen ist, ein Umschalten zwischen einer positiven Spannung und einer negativen Spannung durchzuführen, um die jeweiligen Diodenbrücken in dem zweiten Zustand mit einer Durchlassspannung zu betreiben und die jeweiligen Diodenbrücken in dem ersten Zustand mit einer Sperrspannung zu betreiben.

2. Ultraschallsystem (100) nach Anspruch 1, wobei das Umschaltmodul (240) dafür vorgesehen ist, die Diodenbrücken so zu steuern, dass sie einzeln oder gleichzeitig umschaltbar sind.

3. Ultraschallsystem (100) welches Folgendes aufweist:

eine Übertragungseinheit (110), die dafür vorgesehen ist, eine Vielzahl von Übertragungssignalen zu bilden;
eine Ultraschallsonde (120), die dafür vorgesehen ist, die Übertragungssignale in eine Vielzahl von Ultraschallsignalen zu konvertieren, die Ultraschallsignale zu einem Zielobjekt zu übertragen, eine Vielzahl von von dem Zielobjekt reflektierten Echosignalen zu empfangen und eine Vielzahl von auf den Echosignalen basierenden Empfangssignalen zu bilden; und
eine Empfangseinheit (130);
gekennzeichnet durch
eine Umschalteinheit (140), die mit der Übertragungseinheit (110), der Ultraschallsonde (120) und der Empfangseinheit (130) verbunden ist und ein Umschaltmodul (240) aufweist, welches eine Vielzahl von Schalterpaaren (SW1, SW2) aufweist, die mit den jeweiligen Diodenbrücken

verbunden sind, wobei jedes Schalterpaar (SW1, SW2) dafür vorgesehen ist, ein Umschalten zwischen einer positiven Spannung und einer negativen Spannung durchzuführen; und
eine Spannungsmesseinheit, die dafür vorgesehen ist, eine Spannung von jedem der Übertragungssignale zu messen, um eine gemessene Spannung zu bilden;
eine Steuereinheit (150), die dafür vorgesehen ist, die folgenden Schritte durchzuführen:

Vergleichen der gemessenen Spannung mit einer vorbestimmten Grenzspannung,
Steuern der Umschaltmodule (240), um die Diodenbrücken mit einer Sperrspannung zu betreiben, um zu verhindern, dass das Umschaltsignal zu der Empfangseinheit übertragen wird, wenn die gemessene Spannung über der vorbestimmten Grenzspannung ist, und
Steuern des Umschaltmoduls (240) um die Diodenbrücken mit einer Durchlassspannung zu betreiben, um es dem Empfangssignal zu ermöglichen, zu der Empfangseinheit übertragen zu werden, wenn die gemessene Spannung unter der vorbestimmten Grenzspannung ist.

Revendications

1. Système ultrasonique (100) comportant :

une unité de transmission (110) configurée pour former une pluralité de signaux de transmission ;
une sonde ultrasonique (120) configurée pour convertir les signaux de transmission en une pluralité de signaux ultrasoniques, pour transmettre les signaux ultrasoniques vers un objet cible, pour recevoir une pluralité de signaux d'écho réfléchis par l'objet cible et pour former une pluralité de signaux de réception basés sur les signaux d'écho, et
une unité de réception (130) ;
caractérisé en ce qu'il comporte :

une unité de commutation (140) couplée à l'unité de transmission (110), la sonde ultrasonique (120) et l'unité de réception (130) et comportant une pluralité de ponts de diodes dont chacun est commutable entre un premier état et un second état de telle manière que le signal de transmission correspondant soit bloqué pour ne pas être transmis à l'unité de réception (130) lorsque le pont de diodes est dans le premier état, et le signal correspondant est autorisé à être propagé vers l'unité de réception (130) lorsque le pont de diodes est dans le second état,
dans lequel l'unité de commutation (140) comporte en outre un module de commutation (240) comprenant une pluralité de paires de commutateurs (SW1, SW2) connectés aux ponts de diodes respectifs, dans lequel chaque paire de commutateurs (SW1, SW2) est configurée pour effectuer une commutation entre une tension positive et une tension négative pour polariser les ponts de diodes respectifs dans le second état et pour inverser la polarité des ponts de diodes respectifs dans le premier état.

2. Système ultrasonique (100) de la revendication 1, dans lequel le module de commutation (240) est configuré pour commander les ponts de diodes pour qu'ils soient commutables individuellement ou simultanément.

3. Système ultrasonique (100) comportant :

une unité de transmission (110) pour former une pluralité de signaux de transmission ;
une sonde ultrasonique (120) configurée pour convertir les signaux de transmission en une pluralité de signaux ultrasoniques, pour transmettre les signaux ultrasoniques vers un objet cible, pour recevoir une pluralité de signaux d'écho réfléchis par l'objet cible et pour former une pluralité de signaux de réception basés sur les signaux d'écho, et
une unité de réception (130) ;
caractérisé en ce qu'il comporte :

une unité de commutation (140) couplée à l'unité de transmission (110), la sonde ultrasonique (120) et l'unité de réception (130) et comportant un module de commutation (240) comprenant une pluralité de paires de commutateurs (SW1, SW2) connectés aux ponts de diodes respectifs, dans lequel chaque paire de commutateurs (SW1, SW2) est configurée pour effectuer une commutation entre une tension positive et une tension négative ; et
une unité de mesure de tension configurée pour mesurer une tension de chacun des signaux transmis pour définir une tension mesurée ;

une unité de commande (150) configurée pour effectuer les phases suivantes :

comparer les tensions mesurées avec une tension moyenne prédéterminée,

commander le module de commutation (240) pour inverser la tension des ponts de diodes pour bloquer la transmission du signal de transmission vers l'unité de réception si la tension mesurée est au-dessus de la tension moyenne prédéterminée, et

commander le module de commutation (240) pour polariser les ponts de diodes pour autoriser la transmission du signal de réception vers l'unité de réception si la tension mesurée est en-dessous de la tension moyenne prédéterminée.

FIG. 1

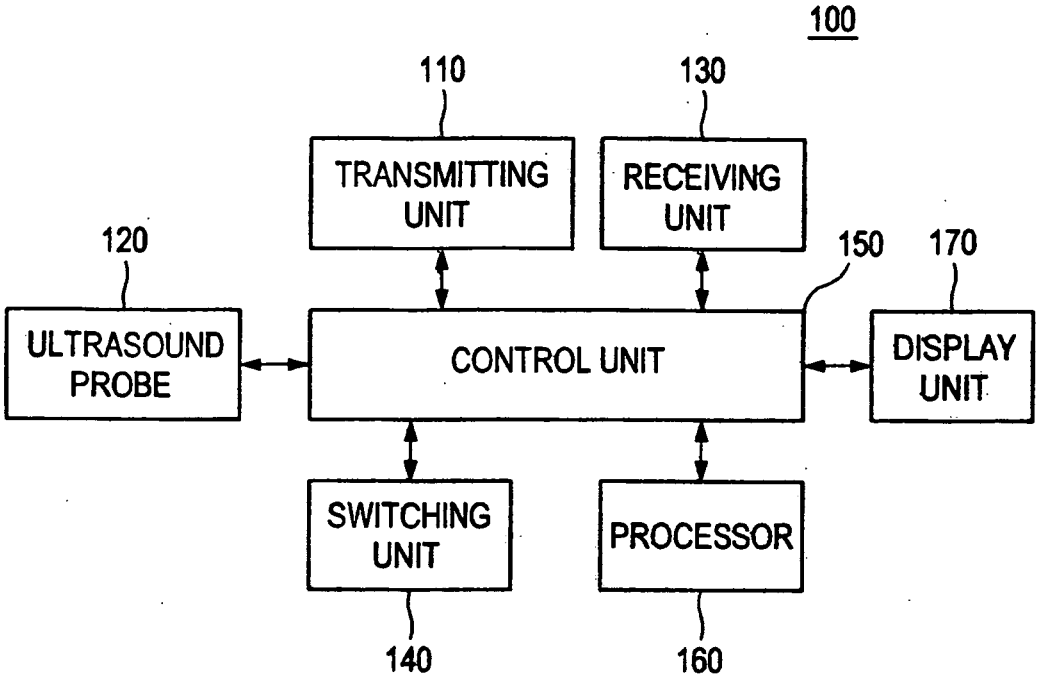
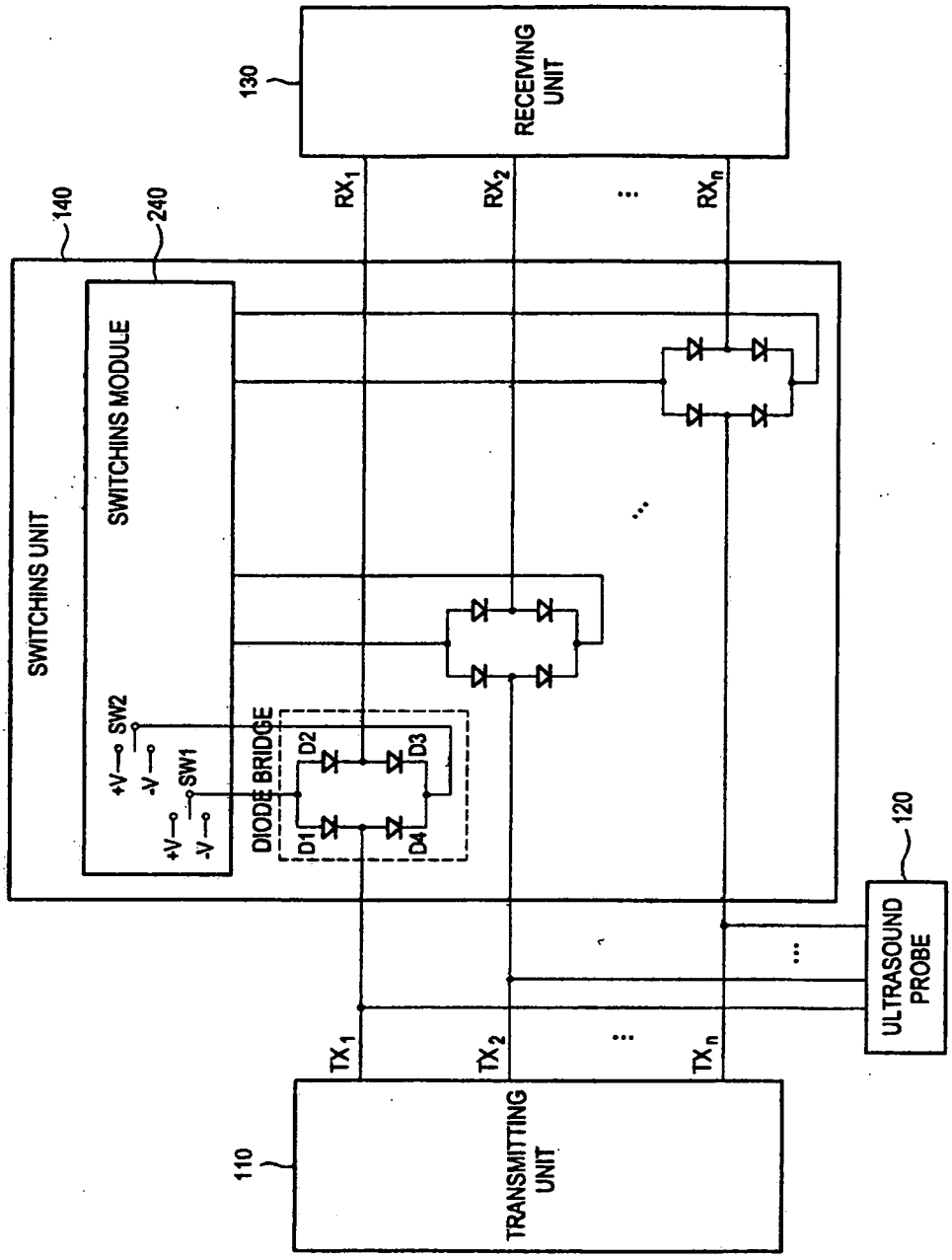

100
110
130
TRANSMITTING UNIT
RECEIVING UNIT
120
150
170
ULTRASOUND PROBE
CONTROL UNIT
DISPLAY UNIT
SWITCHING UNIT
PROCESSOR
140
160

FIG. 2


130
RECEIVING UNIT
RX1
RX2
RXn
140
240
SWITCHINS UNIT
SWITCHINS MODULE
SW2
SW1
+V
-V
DIODE BRIDGE
D1
D2
D3
D4
120
ULTRASOUND PROBE
TX1
TX2
TXn
110
TRANSMITTING UNIT

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 0661008 A1 **[0005]**
- JP 2007001463 A **[0006]**

专利名称(译)	超声系统的发送/接收隔离		
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当前申请(专利权)人(译)	三星MEDISON CO.，LTD.		
[标]发明人	LEE HONG GYO		
发明人	LEE, HONG GYO		
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摘要(译)

公开了一种用于超声系统的发射/接收隔离，以阻止高压发射信号在超声信号的发射周期期间传播到接收单元。一种超声系统，包括：发送单元，被配置为形成多个发送信号;超声探头，被配置为将发射信号转换为多个超声信号，将超声信号发射到目标对象，接收从目标对象反射的多个回波信号，并基于回波信号形成多个接收信号;接收单位;开关单元，耦合到发送单元，超声探头和接收单元，并且包括多个二极管桥，每个二极管桥可在第一和第二状态之间切换，使得当二极管阻止相应的发送信号传播到接收单元。当二极管桥处于第二状态时，桥接器处于第一状态，并且允许相应的接收信号传播到接收单元。