

Description

This invention concerns a display driver amplifier and output signal coupling network for providing a high level video output signal to an image display device.

In a television receiver a video output display driver amplifier provides a high level video output signal to an image display device such as a kinescope. The video output signal is conveyed via an output signal coupling path to a signal input electrode of the kinescope, e.g., a cathode electrode. The kinescope signal input electrode can exhibit a capacitance which is large enough to impair the high frequency response of the video signal developed at the output of the driver amplifier. Thus it is desirable to reduce the effect of the kinescope capacitance upon the driver amplifier output signal, thereby preventing degraded video signal high frequency response and degraded image resolution.

According to the present invention, there is provided a video signal processing system for use with an image display device having a signal input electrode with an associated capacitance comprising: a display driver amplifier having a signal input for receiving a video signal containing information to be displayed, and having an output circuit for developing a video output signal with a magnitude suitable for driving said image display device; and a signal coupling path for conveying said video output signal from said output circuit to said signal input electrode of said image display device;

characterized in that for reducing the effect of said associated capacitance upon said output circuit of said display driver amplifier said signal coupling path comprises: a first emitter follower transistor of a first conductivity type having a base input electrode coupled to said output circuit of said driver amplifier, a collector electrode and an emitter output electrode, for isolating said output circuit of said driver amplifier from said associated capacitance in the presence of video signal amplitude transients of one polarity; a second emitter follower transistor of a second conductivity type arranged in cascade with said first transistor and having a base input electrode coupled to said emitter output electrode of said first transistor, a collector electrode and an emitter output electrode coupled to said signal input electrode of said display device, for isolating said output circuit of said driver amplifier from said associated capacitance in the presence of video signal amplitude transients of another polarity; a first unidirectional current conducting semiconductor device coupled across a base-emitter junction of said first transistor and poled for forward current conduction in a direction

opposite to that of said base-emitter junction of said first transistor; and a second unidirectional current conducting semiconductor device coupled across a base-emitter junction of said second transistor and poled for forward current conduction in a direction opposite to that of said base-emitter junction of said second transistor.

In an embodiment of the present invention, the video output signal coupling path conveys a video signal from the output of the display driver amplifier to the input of a kinescope by means of first and second cascaded emitter follower transistors of opposite conductivity type. The follower transistors respectively isolate the display driver output from the kinescope capacitance in the presence of positive and negative video signal amplitude excursions. First and second unidirectional current conducting devices, such as diodes, are respectively connected across the base-emitter junctions of each transistor and are poled for forward current conduction in a direction opposite to that of the associated base-emitter junction.

The sole figure of the drawing illustrates a portion of a television receiver including a video output signal coupling network in accordance with the principles of the present invention.

A low level video signal from a source 10 is applied to a kinescope driver stage 20 including an input low voltage common emitter amplifier transistor 22 arranged in a cascode video amplifier configuration with an output high voltage common base amplifier transistor 24. A high level amplified video signal with a magnitude suitable for driving a signal input cathode electrode 30 of a kinescope 35 is developed in a collector output circuit of transistor 24, including a load resistor 25 coupled to a high operating voltage B+ (e.g., +230 volts). An amplified video output signal developed across resistor 25 is coupled to cathode electrode 30 via a network 26, a frequency compensated drive level compensation network 27 in accordance with the principles of the present invention, and a kinescope arc current limiting resistor 28, commonly referred to as a "flashover" resistor, operatively associated with network 27. The signal gain and the DC bias of driver stage 20 are respectively adjusted by means of a variable resistor 38 and a potentiometer 39 in the emitter circuit of transistor 22. Operating voltages for kinescope 35 are provided by a source 36.

A capacitance C3 represents parasitic kinescope and wiring capacitance associated with kinescope cathode electrode 30. The value of this capacitance is approximately 9 picofarads and can result in significant high frequency degradation if it is permitted to influence the video signal developed across resistor 25 in the output circuit of transistor 24. Network 26 is arranged to reduce or eliminate

such high frequency degradation by decoupling such capacitance from the collector output circuit of transistor 24.

Coupling network 26 includes an NPN emitter follower transistor 41 with a low impedance emitter output electrode and a PNP emitter follower transistor 42 with a low impedance emitter output electrode arranged in cascade in the output signal path from the collector output circuit of transistor 24 to kinescope 30. Parasitic collector-base capacitances C1 and C2, e.g., 2 picofarads, are respectively associated with transistors 41 and 42 and include stray wiring and layout capacitances. Diodes 43 and 44 are coupled across the base-emitter junctions of transistors 41 and 42, respectively, and are poled for forward current conduction in a direction opposite to the forward current conduction direction of the associated base-emitter junction.

A rapid positive amplitude transition, which contains significant high frequency image detail information, is conveyed to kinescope 35 via conductive transistor 41 and conductive diode 44. Diode 43 and transistor 42 are reverse biased (nonconductive) at this time.

In the case of a rapid positive-going video signal amplitude transition at the collector output of transistor 24, the capacitance presented to the collector output of transistor 24 is substantially equal to

$$C1 + C2/\beta_{41} + C3/\beta_{41} \quad (1)$$

where capacitances C1, C2 and C3 are as discussed above and β_{41} is the forward current gain (Beta) of transistor 41, typically 100 minimum. Thus at the collector of driver transistor 24 the value of kinescope capacitance C3 is greatly reduced by the Beta (β) of transistor 41, and the value of relatively small capacitance C2 is reduced further by the Beta of transistor 41. Resistor 28 assists to isolate the kinescope capacitance from the output circuit of driver transistor 24, but the effect of such action is much less than that produced by network 26.

Rapid negative amplitude transitions, which also contain significant high frequency image detail information, are conveyed to kinescope 35 via conductive diode 43 and transistor 42. Transistor 41 and diode 44 are reverse biased at this time. For rapid negative-going video signal amplitude transitions at the collector output of transistor 24, the capacitance presented to the collector output of transistor 24 is substantially equal to

$$C1 + C2 + C3/\beta_{42} \quad (2)$$

where β_{42} is the forward current gain of transistor

42, typically 100 minimum. Thus the relatively large value of kinescope capacitance C3 is greatly reduced by the Beta of transistor 42 at the collector of driver transistor 24.

A relatively large bypass capacitor 54 shunting a resistor 52 in network 27, as will be discussed subsequently, has a negligible effect upon the value of capacitance given by expressions (1) and (2) above since the value of capacitance presented to the emitter of transistor 42 is dominated by capacitance C3.

Note that the base-emitter junctions of transistors 41 and 42 are not bypassed by capacitors. Such bypassing of one or both of these transistors would defeat the purpose of isolating the output circuit of transistor 24 from capacitances such as kinescope capacitance C3 and capacitor 54 in this example, in the presence of positive or negative signal amplitude transients or both.

A display driver stage including coupling network 26 has been found to exhibit a significant improvement in high frequency response due to decoupling kinescope capacitance C3 from the output circuit of transistor 24, as well as a substantially symmetrical positive and negative transient response. In the latter regard it is noted that expressions (1) and (2) above contain different values of capacitance for positive and negative amplitude transients. The difference is small, however, and transistor 24 can more easily drive a capacitive load when exhibiting increasing current conduction and an associated decreasing collector impedance in response to negative signal amplitude excursions, compared to driving a capacitance when exhibiting decreasing conduction and increasing collector impedance in response to positive amplitude excursions.

Network 26 can assume configurations other than that shown. For example, when a PNP transistor is employed for driver 24 the positions of transistors 41 and 42 with associated diodes 43 and 44 should be interchanged.

With the disclosed arrangement the value of collector load resistor 25 can be lowered in value because the kinescope does not directly load the collector circuit of transistor 24, i.e., the collector circuit is buffered via follower transistors 41 and 42. A lower value of collector load resistance advantageously enhances high frequency response since a smaller resistance value produces less of a lowpass filtering effect together with parasitic collector circuit capacitances.

Network 27 includes a series coupling resistor 52 and a frequency compensation capacitor 54 arranged in parallel as shown, together with flashover resistor 28. A resistor 56 is coupled between an operating voltage (B+) and a point in the signal path to which capacitor 54 is coupled.

Network 27 compensates for the tendency of an image display device such as kinescope 35 to "bloom", or conduct excessive current, when driven by a large magnitude video signal from a low impedance source such as the emitter output of PNP follower transistor 42. To this end resistor 28 and resistor 52 do not develop a significant voltage drop for kinescope current conduction in response to a video signal of low to moderate magnitude. However, resistors 52 and 28 develop a significant voltage drop for kinescope current conduction in response to a large magnitude video signal, e.g., representative of a bright image. This voltage drop reduces the signal drive to kinescope cathode electrode 30, thereby reducing or eliminating the likelihood that the kinescope will "bloom" under large signal conditions. The values of resistors 52 and 28 and capacitor 54 are chosen to yield a desired display drive impedance, particularly at low through middle video signal drive levels which determine image brightness and intensity, so as to maintain kinescope current conduction in accordance with a gamma correction function as is known. The values of resistors 52 and 28 can be tailored to provide a desired amount of gamma correction depending on the type of kinescope and its current conduction characteristics.

Capacitor 54 is a high frequency bypass element to compensate for a high frequency loss associated with a lowpass filtering effect produced by the coaction of kinescope capacitance C3 with resistors 28 and 52. The high frequency compensation provided by network 27 begins at approximately 500 KHz, which is well within the DC to 4.2 MHz video signal band according to NTSC standards. The amount of high frequency compensation, including high frequency boost, is a function of the values of capacitor 54, resistors 52 and 28, capacitance C3 and the impedance of kinescope cathode 30. The impedance of cathode 30 is a function of the current conduction level of cathode 30. In this example, more high frequency compensation is provided at higher cathode current levels.

Capacitor 54 could be coupled across resistor 28 instead of across resistor 52 as illustrated. However, it is preferred that the non-bypassed resistor be located as close to the kinescope as possible to minimize the damage to circuit boards and associated circuit elements due to kinescope arcing. Placing bypass capacitor 54 across both resistors 52 and 28 would defeat the intended arc current protection since such a capacitor coupling would provide an arc current path circumventing the current limiting effect of resistor 28 in this case.

Resistor 56 provides a bias for kinescope cathode 30 to assure that the kinescope is blanked

during retrace intervals. Resistor 56 also assists capacitor 54 in providing the desired high frequency compensation at various signal drive levels. Specifically, resistor 56 helps to stabilize the effective impedance presented to the network including resistor 52 and capacitor 54, in the presence of kinescope impedance variations associated with changes in the level of kinescope current conduction due to changes in the drive signal level.

Claims

1. A video signal processing system for use with an image display device (35) having a signal input electrode with an associated capacitance (C3) comprising:

a display driver amplifier (20) having a signal input for receiving a video signal containing information to be displayed, and having an output circuit for developing a video output signal with a magnitude suitable for driving said image display device; and

a signal coupling path for conveying said video output signal from said output circuit to said signal input electrode of said image display device;

characterized in that for reducing the effect of said associated capacitance upon said output circuit of said display driver amplifier said signal coupling path comprises:

a first emitter follower transistor (41) of a first conductivity type having a base input electrode coupled to said output circuit of said driver amplifier, a collector electrode and an emitter output electrode, for isolating said output circuit of said driver amplifier from said associated capacitance in the presence of video signal amplitude transients of one polarity;

a second emitter follower transistor (42) of a second conductivity type arranged in cascade with said first transistor and having a base input electrode coupled to said emitter output electrode of said first transistor, a collector electrode and an emitter output electrode coupled to said signal input electrode of said display device, for isolating said output circuit of said driver amplifier from said associated capacitance in the presence of video signal amplitude transients of another polarity;

a first unidirectional current conducting semiconductor device (43) coupled across a base-emitter junction of said first transistor and poled for forward current conduction in a direction opposite to that of said base-emitter junction of said first transistor; and

a second unidirectional current conducting semiconductor device (44) coupled across a



Network 27 compensates for the tendency of an image display device such as kinescope 35 to "bloom", or conduct excessive current, when driven by a large magnitude video signal from a low impedance source such as the emitter output of PNP follower transistor 42. To this end resistor 28 and resistor 52 do not develop a significant voltage drop for kinescope current conduction in response to a video signal of low to moderate magnitude. However, resistors 52 and 28 develop a significant voltage drop for kinescope current conduction in response to a large magnitude video signal, e.g., representative of a bright image. This voltage drop reduces the signal drive to kinescope cathode electrode 30, thereby reducing or eliminating the likelihood that the kinescope will "bloom" under large signal conditions. The values of resistors 52 and 28 and capacitor 54 are chosen to yield a desired display drive impedance, particularly at low through middle video signal drive levels which determine image brightness and intensity, so as to maintain kinescope current conduction in accordance with a gamma correction function as is known. The values of resistors 52 and 28 can be tailored to provide a desired amount of gamma correction depending on the type of kinescope and its current conduction characteristics.

Capacitor 54 is a high frequency bypass element to compensate for a high frequency loss associated with a lowpass filtering effect produced by the coaction of kinescope capacitance C3 with resistors 28 and 52. The high frequency compensation provided by network 27 begins at approximately 500 KHz, which is well within the DC to 4.2 MHz video signal band according to NTSC standards. The amount of high frequency compensation, including high frequency boost, is a function of the values of capacitor 54, resistors 52 and 28, capacitance C3 and the impedance of kinescope cathode 30. The impedance of cathode 30 is a function of the current conduction level of cathode 30. In this example, more high frequency compensation is provided at higher cathode current levels.

Capacitor 54 could be coupled across resistor 28 instead of across resistor 52 as illustrated. However, it is preferred that the non-bypassed resistor be located as close to the kinescope as possible to minimize the damage to circuit boards and associated circuit elements due to kinescope arcing. Placing bypass capacitor 54 across both resistors 52 and 28 would defeat the intended arc current protection since such a capacitor coupling would provide an arc current path circumventing the current limiting effect of resistor 28 in this case.

Resistor 56 provides a bias for kinescope cathode 30 to assure that the kinescope is blanked

during retrace intervals. Resistor 56 also assists capacitor 54 in providing the desired high frequency compensation at various signal drive levels. Specifically, resistor 56 helps to stabilize the effective impedance presented to the network including resistor 52 and capacitor 54, in the presence of kinescope impedance variations associated with changes in the level of kinescope current conduction due to changes in the drive signal level.

Claims

1. A video signal processing system for use with an image display device (35) having a signal input electrode with an associated capacitance (C3) comprising:
 - a display driver amplifier (20) having a signal input for receiving a video signal containing information to be displayed, and having an output circuit for developing a video output signal with a magnitude suitable for driving said image display device; and
 - a signal coupling path for conveying said video output signal from said output circuit to said signal input electrode of said image display device;
 characterized in that for reducing the effect of said associated capacitance upon said output circuit of said display driver amplifier said signal coupling path comprises:
 - a first emitter follower transistor (41) of a first conductivity type having a base input electrode coupled to said output circuit of said driver amplifier, a collector electrode and an emitter output electrode, for isolating said output circuit of said driver amplifier from said associated capacitance in the presence of video signal amplitude transients of one polarity;
 - a second emitter follower transistor (42) of a second conductivity type arranged in cascade with said first transistor and having a base input electrode coupled to said emitter output electrode of said first transistor, a collector electrode and an emitter output electrode coupled to said signal input electrode of said display device, for isolating said output circuit of said driver amplifier from said associated capacitance in the presence of video signal amplitude transients of another polarity;
 - a first unidirectional current conducting semiconductor device (43) coupled across a base-emitter junction of said first transistor and poled for forward current conduction in a direction opposite to that of said base-emitter junction of said first transistor; and
 - a second unidirectional current conducting semiconductor device (44) coupled across a



base-emitter junction of said second transistor and poled for forward current conduction in a direction opposite to that of said base-emitter junction of said second transistor.

2. A system according to Claim 1, characterized in that

said display driver amplifier (20) includes a transistor (24) of the same conductivity type as said first transistor.

3. A system according to Claim 1 or 2, characterized in that

said first (41) and second (42) transistors are NPN and PNP devices, respectively.

4. A system according to any one of the preceding claims characterized in that said signal coupling path includes

first (52) and second (28) resistors coupled in series in the order named from said emitter output of said second transistor to said signal input electrode of said image display device; and

a capacitor (54) coupled across said first resistor.

5. A system according to Claim 4 further characterized by

a third resistor (56) coupled from a voltage source to a point between said first and second resistors.

6. A system according to any preceding claim further comprising an image display device (35) having a signal input electrode with an associated capacitance (C3) coupled to the signal coupling path.

Patentansprüche

1. Videosignal-Verarbeitungssystem zur Verwendung mit einer Bild-Anzeigeeinrichtung (35), die eine Signal-Eingangselektrode mit einer zugeordneten Kapazität (C3) hat, welche aufweist:

- ein Anzeige-Treiberverstärker (20) mit einem Signaleingang zum Erhalt eines Videosignals mit anzuzeigender Information und mit einer Ausgangsschaltung zur Bildung eines Video-Ausgangssignals mit einer Größe, die geeignet ist zur Ansteuerung der Bild-Anzeigeeinrichtung;
- einen Signal-Kopplungspfad zum Weitergeben des Video-Ausgangssignals von der Ausgangsschaltung an die Signal-Eingangselektrode der Bild-

Anzeigeeinrichtung;

dadurch gekennzeichnet,

daß zum Reduzieren des Effektes der assoziierten Kapazität auf die Ausgangsschaltung des Anzeige-Treiberverstärkers der Signal-Kopplungspfad aufweist:

- einen ersten Emitterfolger-Transistor (41) eines ersten Leitfähigkeits-Typs mit einer Basis-Eingangselektrode, die an die Ausgangsschaltung des Treiberverstärkers gekoppelt ist, mit einer Kollektorelektrode und einer Emitter-Ausgangselektrode zum Isolieren der Ausgangsschaltung des Treiberverstärkers von der zugeordneten Kapazität bei Anwesenheit von Videosignal-Amplitudentransienten einer Polarität;
- einen zweiten Emitterfolger-Transistor (42) eines zweiten Leitfähigkeits-Typs, der in Kaskade mit dem ersten Transistor angeordnet ist und eine Basis-Eingangselektrode aufweist, die mit der Emitter-Ausgangselektrode des ersten Transistors gekoppelt ist, sowie eine Kollektorelektrode und eine Emitter-Ausgangselektrode aufweist, die an die Signal-Eingangselektrode der Anzeigeeinrichtung gekoppelt ist, zum Isolieren der Ausgangsschaltung des Treiberverstärkers von der assoziierten Kapazität, in Anwesenheit von Videosignal-Amplitudentransienten einer anderen Polarität;
- eine erste unidirektional stromführende Halbleiter-Einrichtung (43), die (parallel) über eine Basis-Emitterverbindung des ersten Transistors gekoppelt ist und zur Vorwärts-Stromführung in einer Richtung, die entgegengesetzt derjenigen der Basis-Emitter-Verbindung des ersten Transistors ist, gepolt ist; und
- daß eine zweite - unidirektional stromführende Halbleiter-Einrichtung (44) (parallel) über eine Basis-Emitter-Verbindung des zweiten Transistors gekoppelt ist und zur Vorwärts-Stromführung in einer Richtung gepolt ist, die entgegengesetzt zu der der Basis-Emitter-Verbindung des zweiten Transistors ist.

2. System nach Anspruch 1,

dadurch gekennzeichnet,

daß der Anzeige-Treiberverstärker (20) einen Transistor (24) desselben Leitfähigkeits-Typs beinhaltet, wie der erste Transistor.



3. System nach Anspruch 1 oder 2, **dadurch gekennzeichnet**, daß die ersten (41) bzw. zweiten (42) Transistoren NPN bzw. PNP Bauteile sind.

4. System nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**, daß der Signal-Kopplungspfad beinhaltet:

- erste (52) und zweite (28) Widerstände, die in Serie gekoppelt sind in der Reihenfolge die von dem Emitterausgang des zweiten Transistors an die Signaleingangselektrode der Bild-Anzeigeeinrichtung angegeben wird;
- eine Kapazität (54), die über den ersten Widerstand (parallel) gekoppelt ist.

5. System nach Anspruch 4, **dadurch gekennzeichnet**, daß ein dritter Widerstand (56) von einer Spannungsquelle zu einem Punkt zwischen ersten und zweiten Widerständen gekoppelt ist.

6. System nach einem der vorgehenden Ansprüche, **dadurch gekennzeichnet**, daß eine Bild-Anzeigeeinrichtung (35) vorgesehen ist, die eine Signaleingangselektrode mit einer zugeordneten (associated) Kapazität (C3) hat, die an die Signal-Kopplungspfade gekoppelt ist.

Revendications

1. Système de traitement de signaux vidéo devant être utilisé avec un dispositif d'affichage d'images (35) ayant une électrode d'entrée de signaux avec une capacité associée (C3), comprenant :

- un amplificateur de commande d'affichage (20) ayant une entrée de signaux pour recevoir un signal vidéo contenant de l'information devant être affichée et ayant un circuit de sortie pour développer un signal de sortie vidéo avec une amplitude apte à commander ledit dispositif d'affichage d'images et
- une trajectoire de couplage de signaux pour convoyer ledit signal de sortie vidéo depuis ledit circuit de sortie jusqu'à l'électrode d'entrée de signaux du dispositif d'affichage d'images ; caractérisé en ce que pour réduire l'effet de ladite capacité associée sur ledit circuit de sortie de l'amplificateur de commande d'affichage, ladite trajectoire de

couplage de signaux comprend :

- un premier transistor émetteur suiveur (41) d'un premier type de conductivité ayant une entrée de base couplée audit circuit de sortie de l'amplificateur de commande, un collecteur et une sortie d'émetteur, pour isoler ledit circuit de sortie dudit amplificateur de commande de ladite capacité associée, en présence de transitoires d'amplitudes de signaux vidéo d'une polarité ;
- un second transistor émetteur suiveur (42) d'un second type de conductivité, disposé en cascade avec ledit premier transistor et comportant une entrée de base couplée à ladite sortie d'émetteur dudit premier transistor, un collecteur et une sortie d'émetteur couplés à ladite électrode d'entrée de signaux du dispositif d'affichage, pour isoler ledit circuit de sortie de l'amplificateur de commande de ladite capacité associée, en présence de transitoires d'amplitudes de signaux vidéo d'une autre polarité ;
- un premier dispositif semi-conducteur, conducteur de courant unidirectionnel (43), couplé sur la fonction base-émetteur dudit premier transistor et polarisé pour une conduction de courant en direct, dans une direction opposée à celle de ladite jonction base-émetteur dudit premier transistor ; et
- un second dispositif semi-conducteur (44), conducteur de courant unidirectionnel, couplé sur une fonction base-émetteur dudit second transistor et polarisé selon une conduction de courant en direct, dans une direction opposée à celle de la jonction base-émetteur dudit second transistor.

2. Système selon la revendication 1, caractérisé en ce que ledit amplificateur de commande d'affichage (20) comprend un transistor (24) du même type de conductivité que ledit premier transistor.

3. Système selon la revendication 1 ou 2, caractérisé en ce que ledit premier (41) et second (42) transistors sont respectivement des dispositifs NPN et PNP.

4. Système selon l'une quelconque des revendications précédentes caractérisé en ce que ladite trajectoire de couplage de signaux comprend :

- des première (52) et seconde (28) résistances couplées en série dans l'ordre



indiqué, à partir de l'émetteur de sortie dudit second transistor vers ladite électrode d'entrée de signaux du dispositif d'affichage d'images et,

- un condensateur (54) couplé sur ladite première résistance. 5

5. Système selon la revendication 4 caractérisé en outre par : un troisième transistor (56) couplé à partir d'une source de tension vers un point entre ladite première et ladite seconde résistances. 10

6. Système selon l'une quelconque des revendications précédentes comprenant en outre un dispositif d'affichage d'images (35) ayant une électrode d'entrée de signaux avec une capacité associée (C3) couplée à ladite trajectoire de couplage de signaux. 15

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