

Description

This invention relates generally to multiplexing circuits, and more particularly, to a data selection circuit which generates first and second complementary outputs for enabling first and second data paths.

Data selection circuits, of the type with which this invention is concerned, generate first and second complementary output signals which are in turn coupled to different data paths for selectively enabling said data paths. That is, a data path will be enabled only if the data selector output coupled thereto is in a first state (generally a logical "one") and will be disabled if the data selector output is in a second state (generally a logical "zero"). When one of the data paths is enabled (selected), it is necessary that the other data path be disabled (deselected). Unfortunately, many known circuits do not preclude the possibility of both data selection outputs being simultaneously at the logical "zero" level for a brief period of time when the input signal is switched from a logical "zero" to a logical "one". This condition may be referred to as "dual deselection" and results in a glitch which may seriously degrade the data being transmitted.

One circuit which does attempt to overcome this problem is described in US-A-3 624 620. In this case the circuit has an inverting section and a non-inverting section and diodes are cross-coupled from each output to the input of the respective other section to prevent complete saturation of their associated transistors.

Summary of the invention

It is an object of the present invention to provide an improved data selection circuit including apparatus for preventing the circuit's inverting output from becoming a logical "zero" prior to the non-inverting output becoming a logical "one" when the input changes from a logical "zero" to a logical "one".

Accordingly, the invention provides a data selection circuit as defined in claim 1.

Brief description of the drawings

The above features and advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawing which is a schematic diagram of the inventive data selection circuit.

Description of the preferred embodiment

Referring to the drawing, the inventive data selection circuit comprises an inverting section and a non-inverting section. The inverting section comprises transistors 4, 6, 8, 10, 12 and 14, diodes 16, 18, 20, and 22, and resistors 24, 26, 28, 30, and 32. The non-inverting section comprises transistors 34, 36, 38, 40, 42, 44, and 46, diodes 48, 50, 52, and 54, and resistors 56, 58, 60, 62, and 64.

Referring first to the inverting section, an input voltage (V_{in}) appearing at terminal 2 is applied to

the base of an input PNP transistor whose emitter is coupled via resistor 24 to a source of supply voltage (V_{cc}) appearing at terminal 66. The emitter of transistor 4 is also coupled to the anode of Schottky diode 18 and to the base Schottky transistor 6. The collector of transistor 6 is coupled via resistor 26 to the source of supply V_{cc} , and the emitter of transistor 6 is coupled to the base of Schottky transistor 8, the anode of Schottky diode 20, and to the anode of Schottky diode 16. The cathode of Schottky diode 16 is coupled to the base of transistor 4. The collector of transistor 8 is coupled to the base of Schottky transistor 10, to the cathode of Schottky diode 22, and, via resistor 28, to the source of supply voltage V_{cc} . The emitter of transistor 8 is coupled to the base of Schottky transistor 14 and, via resistor 30, to ground. The emitter of transistor 10 is coupled to the base of NPN transistor 12 and, via resistor 32, to the anode of Schottky diode 22 and to the junction of the emitter of transistor 12 and the collector of Schottky transistor 14 which is in common with output terminal 68 at which the inverted output (V_{out}) appears. The collectors of both transistors 10 and 12 are coupled to the source of supply voltage V_{cc} while the emitter of transistor 14 is coupled to ground. Transistor 4 may be referred to as an input transistor while Schottky transistor 6 is a buffer transistor. Transistor 8 is a phase splitter transistor and transistors 10, 12 and 14 are included in what may be referred to as a push-pull output stage.

The non-inverting portion of the circuit includes an input PNP transistor 34, a buffer transistor 36, an inverting transistor 38, a phase splitter transistor 40 and an output push-pull stage including transistors 42, 44 and 46. The input signal V_{in} appearing at terminal 2 is applied to the base of input transistor 34. The emitter of transistor 34 is coupled to the base of Schottky transistor 36 and, via resistor 54, to the source of supply voltage V_{cc} . The collector of Schottky transistor 36 is coupled, via resistor 56, to V_{cc} , and the emitter of transistor 36 is coupled to the base of Schottky transistor 38 and to the anode of Schottky diode 48. The cathode of diode 48 is coupled to the base of transistor 34. The collector of transistor 38 is coupled to the base of Schottky transistor 40 and, via resistor 58, to V_{cc} while the emitter of transistor 38 is coupled via diode 50 to ground. The collector of transistor 40 is coupled to the base of Schottky transistor 42, the cathode of Schottky diode 52 and, via resistor 60, to V_{cc} . The emitter of transistor 40 is coupled to the base of Schottky transistor 46 and, via resistor 62, to ground. The emitter of transistor 42 is coupled to the base of NPN transistor 44 and, via resistor 64, to the anode of Schottky diode 52 and to the junction of the emitter of transistor 44 and the collector of Schottky transistor 46 which junction is in common with the non-inverting output terminal 70 (V_{out}). The collector terminals of transistors 42 and 44 are coupled to V_{cc} while the emitter terminal of transistor 46 is coupled to ground.

The inventive selector circuit shown in the

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drawing operates as follows. With a low voltage at terminal 2 (V_{IN} is a logical "zero") input transistor 4 is rendered conductive which in turn renders transistor 6 nonconductive. Since no base drive is being supplied to transistor 8, transistor 8 remains off causing transistors 10 and 12 to be rendered conductive. With transistor 8 off, no base drive is supplied to transistor 14 keeping it off. Thus, the voltage at terminal 68 (V_{out}) will go high; i.e. V_{out} becomes a logical "one".

Since a low voltage exists at input terminal 2, transistor 34 will become conductive causing transistor 36 to be rendered nonconductive so as not to supply base drive to transistor 38 to turn it on. With transistor 38 off, transistor 40 is turned on causing base drive to be diverted from transistor 42 and supplied to the base of transistor 46 turning transistor 46 on. With transistor 42 turned off, transistor 44 is likewise off and thus the voltage at output terminal 70 (V_{out}) will go low; i.e. V_{out} becomes a logical "zero".

When V_{IN} at a terminal 2 switches from a low to a high (i.e. from a logical zero to a logical one) both input transistors 4 and 34 will begin to turn off. Ignoring Schottky diodes 18 and 20 for the time being, Schottky transistor 6 will begin to turn on when input transistor 4 turns off. When transistor 6 is sufficiently on, there will be sufficient base drive to transistor 8 likewise turning it on. This will cause transistor 14 to become conductive and transistors 10 and 12 to become nonconductive causing output terminal 68 to go low; i.e. V_{out} becomes a logical zero.

In response to transistor 34 turning off, transistor 36 will turn on supplying base drive to transistor 38. When transistor 38 turns on, transistor 40 will turn off removing base drive from transistor 46 and supplying base drive to transistor 42. Thus, transistor 46 turns off and transistor 44 turns on causing the output voltage V_{out} at terminal 70 to go high; i.e. V_{out} becomes a logical "one".

As can be seen, the non-inverting portion of the circuit includes one additional inverting stage when compared to the inverting portion of the circuit. Thus, when the input voltage switches from a logical zero to a logical one, the inverting output terminal 68 may be driven low prior to the non-inverting output 70 being driven high. Thus, for some period of time, both outputs V_{out} and V_{out} would be low. To avoid this, a Schottky diode 18 is placed between the base of transistor 6 in the inverting portion of the circuit and the junction of the emitter of transistor 44 and the collector of transistor 46 in a noninverting portion of the circuit. Thus, when the input voltage V_{IN} goes from a low to a high causing transistor 4 to turn off, Schottky diode 18 diverts base drive from transistor 6 causing transistor 6 to remain off which in turn causes transistors 8 and 14 to remain off. Thus, the voltage at terminal 68 remains high. When the collector of transistor 46 reaches the threshold for transistors 6, 8 and 14 due to the input voltage switching from a low to a high level, Schottky diodes 18 and 20 become reverse biased. Thus, base drive is supplied to transistor 6 turning

it on. Once transistor 6 is turned on, base drive is applied to transistor 8 turning it on which in turn causes transistor 14 to become conductive and output terminal 68 to go low. As can be seen, output terminal 68 cannot go low until output terminal 70 reaches a high enough level thus avoiding the problem of dual deselection. Schottky diode 20 serves merely to divert current which may be coupled via diode 16 into the base of transistor 8 during the low-to-high transition at terminal 2.

Schottky diodes 16 and 48 are placed between the base of transistors 8 and 38 respectively and transistors 4 and 34 respectively for the purpose of removing charge when the input voltage at terminal 2 goes low. Resistors 30 and 62 provide base charge removal paths for transistors 14 and 46 respectively. Resistor 32 in conjunction with Schottky diode 22 provides a means for removing charges from the base of transistor 12 while resistor 64 in conjunction with diode 52 provides a charge removal path for transistor 44. Furthermore, since the anodes of diodes 22 and 52 are coupled to output terminals 68 and 70 respectively, diodes 22 and 52 provides means for discharging capacitive loads. Finally, resistors 24, 26, 28, 54, 56, 58, and 60 are merely bias resistors to set appropriate current levels.

Diode 72 assures that the voltage V_{IN} at terminal 2 does not fall significantly below ground.

Although reference has been made throughout the specification to Schottky diodes and Schottky transistors, it should be clear to one skilled in the art that such devices may be replaced by traditional diodes and transistors and still yield an operative circuit.

Claims

1. A data selection circuit for selectively generating mutually complementary signals at first and second outputs (68, 70) thereof in response to an input signal (V_{IN}) which is capable of assuming first and second states, said data selection circuit characterized by:

an inverting section comprising a first transistor (4) having a base coupled to said input signal, an emitter coupled to a first source (66) of supply voltage by a first resistor (24), and a collector coupled to a second source (ground) of supply voltage;

a second transistor (6) having a base coupled to the emitter of said first transistor (4), a collector coupled to said first source (66) of supply voltage by a second resistor (26), and an emitter;

a first inverting stage (8, 28) having an input coupled to the emitter of said second transistor (6);

a first push-pull output stage (10, 12, 14, 22, 30, 32) having an input coupled to an output of said first inverting stage (8, 28) and an output coupled to said first output (68); and

a non-inverting section comprising a non-inverting input stage (34, 36, 54, 56) for receiving said input signal;

a second inverting stage (38, 58) having an input

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Since a low voltage exists at input terminal 2, transistor 34 will become conductive causing transistor 36 to be rendered nonconductive so as not to supply base drive to transistor 38 to turn it on. With transistor 38 off, transistor 40 is turned on causing base drive to be diverted from transistor 42 and supplied to the base of transistor 46 turning transistor 46 on. With transistor 42 turned off, transistor 44 is likewise off and thus the voltage at output terminal 70 (V_{out}) will go low; i.e. V_{out} becomes a logical "zero".

When V_{IN} at a terminal 2 switches from a low to a high (i.e. from a logical zero to a logical one) both input transistors 4 and 34 will begin to turn off. Ignoring Schottky diodes 18 and 20 for the time being, Schottky transistor 6 will begin to turn on when input transistor 4 turns off. When transistor 6 is sufficiently on, there will be sufficient base drive to transistor 8 likewise turning it on. This will cause transistor 14 to become conductive and transistors 10 and 12 to become nonconductive causing output terminal 68 to go low; i.e. V_{out} becomes a logical zero.

In response to transistor 34 turning off, transistor 36 will turn on supplying base drive to transistor 38. When transistor 38 turns on, transistor 40 will turn off removing base drive from transistor 46 and supplying base drive to transistor 42. Thus, transistor 46 turns off and transistor 44 turns on causing the output voltage V_{out} at terminal 70 to go high; i.e. V_{out} becomes a logical "one".

As can be seen, the non-inverting portion of the circuit includes one additional inverting stage when compared to the inverting portion of the circuit. Thus, when the input voltage switches from a logical zero to a logical one, the inverting output terminal 68 may be driven low prior to the non-inverting output 70 being driven high. Thus, for some period of time, both outputs V_{out} and V_{out} would be low. To avoid this, a Schottky diode 18 is placed between the base of transistor 6 in the inverting portion of the circuit and the junction of the emitter of transistor 44 and the collector of transistor 46 in a noninverting portion of the circuit. Thus, when the input voltage V_{IN} goes from a low to a high causing transistor 4 to turn off, Schottky diode 18 diverts base drive from transistor 6 causing transistor 6 to remain off which in turn causes transistors 8 and 14 to remain off. Thus, the voltage at terminal 68 remains high. When the collector of transistor 46 reaches the threshold for transistors 6, 8 and 14 due to the input voltage switching from a low to a high level, Schottky diodes 18 and 20 become reverse biased. Thus, base drive is supplied to transistor 6 turning

it on. Once transistor 6 is turned on, base drive is applied to transistor 8 turning it on which in turn causes transistor 14 to become conductive and output terminal 68 to go low. As can be seen, output terminal 68 cannot go low until output terminal 70 reaches a high enough level thus avoiding the problem of dual deselection. Schottky diode 20 serves merely to divert current which may be coupled via diode 16 into the base of transistor 8 during the low-to-high transition at terminal 2.

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Diode 72 assures that the voltage V_{IN} at terminal 2 does not fall significantly below ground.

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an inverting section comprising a first transistor (4) having a base coupled to said input signal, an emitter coupled to a first source (66) of supply voltage by a first resistor (24), and a collector coupled to a second source (ground) of supply voltage;

a second transistor (6) having a base coupled to the emitter of said first transistor (4), a collector coupled to said first source (66) of supply voltage by a second resistor (26), and an emitter;

a first inverting stage (8, 28) having an input coupled to the emitter of said second transistor (6);

a first push-pull output stage (10, 12, 14, 22, 30, 32) having an input coupled to an output of said first inverting stage (8, 28) and an output coupled to said first output (68); and

a non-inverting section comprising a non-inverting input stage (34, 36, 54, 56) for receiving said input signal;

a second inverting stage (38, 58) having an input



coupled to an output of said non-inverting input stage;

a third inverting stage (40, 60) having an input coupled to an output of said second inverting stage (38);

a second push-pull output stage (42, 44, 46, 52, 64) having an input coupled to an output of said third inverting stage (40) and an output coupled to said second output (70);

a first diode (18) having a cathode coupled to said second output (70) and an anode coupled to the junction of the emitter of said first transistor (4) and the base of said second transistor (6).

2. A circuit according to claim 1 wherein said first diode is a Schottky diode (18).

3. A circuit according to claim 1 wherein said first inverter stage is characterized by a third transistor (8) having a collector coupled to said first source (66) of supply voltage by a third resistor (28), an emitter coupled to said second source (ground) of supply voltage by a fourth resistor (30), and a base coupled to the emitter of said second transistor (6).

4. A circuit according to claim 3 further characterized by a second diode (20) having a cathode coupled to said second output and an anode coupled to the base of said third transistor (8).

5. A circuit according to claim 4 wherein said first push-pull output stage is characterized by:

a fourth transistor (10) having a base coupled to the collector of said third transistor (8), a collector coupled to said first source (66) of supply voltage, and having an emitter;

a fifth transistor (12) having a base coupled to the emitter of said fourth transistor (10), a collector coupled to said first source (66) of supply voltage and an emitter coupled to said first output (68); and

a sixth transistor (14) having a base coupled to the emitter of said third transistor (8), an emitter coupled to said second source (ground) of supply voltage and a collector coupled to said first output (68).

Patentansprüche

1. Datenauswählschaltung zum wahlweisen Erzeugen von zu einander komplementären Signalen an ersten und zweiten Ausgängen (68, 70) derselben in Abhängigkeit von einem Eingangssignal (V_{IN}), das in der Lage ist, erste und zweite Zustände anzunehmen, wobei die Datenauswählschaltung gekennzeichnet ist durch:

ein Inverterteil, enthaltend einen ersten Transistor (4) mit einer Basis, die mit dem Eingangssignal verbunden ist, einem Emitter, der mit einem ersten Pol (66) einer Versorgungsspannungsquelle über einen ersten Widerstand (24) verbunden ist, und einem Kollektor, der mit dem zweiten Pol (Masse) der Versorgungsspannungsquelle verbunden ist;

einen zweiten Transistor (6) mit einer Basis, die mit dem Emitter des ersten Transistors (4) verbunden ist, einem Kollektor, der mit dem

ersten Pol (66) der Versorgungsspannungsquelle über einen zweiten Widerstand (26) verbunden ist, und einem Emitter;

eine erste Inverterstufe (8, 28), deren Eingang mit dem Emitter des zweiten Transistors (6) verbunden ist;

eine erste Gegentaktausgangsstufe (10, 12, 14, 22, 30, 32) mit einem Eingang, der mit einem Ausgang der ersten Inverterstufe (8, 28) verbunden ist, und einem Ausgang, der mit dem ersten Ausgang (68) verbunden ist; und

ein nicht invertierendes Teil, enthaltend eine nicht-invertierende Eingangsstufe (34, 36, 54, 56) zum Aufnehmen des Eingangssignals;

eine zweite Inverterstufe (38, 58) mit einem Eingang, der mit einem Ausgang der nicht-invertierenden Eingangsstufe verbunden ist;

eine dritte Inverterstufe (40, 60) mit einem Eingang, der mit einem Ausgang der zweiten Inverterstufe (38) verbunden ist;

eine zweite Gegentaktausgangsstufe (42, 44, 46, 52, 64) mit einem Eingang, der mit einem Ausgang der dritten Inverterstufe (40) verbunden ist, und einen Ausgang, der mit dem zweiten Ausgang (70) verbunden ist;

eine erste Diode (18), deren Kathode mit dem zweiten Ausgang (70) verbunden ist und deren Anode mit der Verbindung des Emitters des ersten Transistors (4) mit der Basis des zweiten Transistors (6) verbunden ist.

2. Schaltung nach Anspruch 1, bei der die erste Diode eine Schottky-Diode (18) ist.

3. Schaltung nach Anspruch 1, bei der die erste Inverterstufe gekennzeichnet ist durch einen dritten Transistor (8) mit einem Kollektor, der mit dem ersten Pol (66) der Versorgungsspannungsquelle über einen dritten Widerstand (28) verbunden ist, einem Emitter, der mit dem zweiten Pol (Masse) der Versorgungsspannungsquelle über einen vierten Widerstand (30) verbunden ist, und einer Basis, die mit dem Emitter des zweiten Transistors (6) verbunden ist.

4. Schaltung nach Anspruch 3, weiterhin gekennzeichnet durch eine zweite Diode (20), deren Kathode mit dem zweiten Ausgang und deren Anode mit der Basis des dritten Transistors (8) verbunden ist.

5. Schaltung nach Anspruch 4, bei der die erste Gegentaktausgangsstufe gekennzeichnet ist durch:

einen vierten Transistor (10) mit einer Basis, die mit dem Kollektor des dritten Transistors (8) verbunden ist, einem Kollektor, der mit dem ersten Pol (66) der Versorgungsspannungsquelle verbunden ist, und einem Emitter;

einen fünften Transistor (12) mit einer Basis, die mit dem Emitter des vierten Transistors (10) verbunden ist, einem Kollektor, der mit dem ersten Pol (66) der Versorgungsspannungsquelle verbunden ist und einem Emitter, der mit dem ersten Ausgang (68) verbunden ist; und

einen sechsten Transistor (14) mit einer Basis, die mit dem Emitter des dritten Transistors (8) verbunden ist, einem Emitter, der mit dem zwei-



ten Pol (Masse) der Versorgungsspannungsquelle verbunden ist, und einem Kollektor, der mit dem ersten Ausgang (68) verbunden ist.

Revendications

1. Circuit de sélection de données servant à sélectivement produire des signaux mutuellement complémentaires sur une première et une deuxième sortie (68, 70) de celui-ci en réponse à un signal d'entrée (V_{IN}) qui peut prendre un premier et un deuxième état, ledit circuit de sélection de données étant caractérisé par:

une section d'inversion comprenant:

un premier transistor (4) possédant une base couplée audit signal d'entrée, un émetteur couplé à une première source (66) de tension d'alimentation électrique par une première résistance (24), et un collecteur couplé à une deuxième source (la terre) de tension d'alimentation électrique;

un deuxième transistor (6) possédant une base couplée à l'émetteur dudit premier transistor (4), un collecteur couplé à ladite première source (66) d'alimentation électrique par une deuxième résistance (26), et un émetteur;

un premier étage d'inversion (8, 28) possédant une entrée qui est couplée à l'émetteur dudit deuxième transistor (6);

un premier étage de sortie push-pull (10, 12, 14, 22, 30, 32) possédant une entrée couplée à une sortie dudit premier étage d'inversion (8, 28) et une sortie couplée à ladite première sortie (68); et

une section de non-inversion comprenant:

un étage d'entrée de non-inversion (34, 36, 54, 56) servant à recevoir ledit signal d'entrée;

un deuxième étage d'inversion (38, 58) possédant une entrée couplée à une sortie dudit étage d'entrée de non-inversion;

un troisième étage d'inversion (40, 60) possédant une entrée couplée à une sortie dudit deuxième étage d'inversion (38);

un deuxième étage de sortie push-pull (42, 44,

46, 52, 64) possédant une entrée couplée à une sortie dudit troisième étage d'inversion (40) et une sortie couplée à ladite deuxième sortie (70);

une première diode (18) possédant une cathode couplée à ladite deuxième sortie (70) et une anode couplée à la jonction de l'émetteur dudit premier transistor (4) et de la base dudit deuxième transistor (6).

2. Circuit selon la revendication 1, où ladite première diode est une diode de Schottky (18).

3. Circuit selon la revendication 1, où ledit premier étage inverseur est caractérisé par un troisième transistor (8) possédant un collecteur couplé à ladite première source (66) de tension d'alimentation par une troisième résistance (28), un émetteur couplé à ladite deuxième source (la terre) de tension d'alimentation électrique par une quatrième résistance (30), et une base couplée à l'émetteur dudit deuxième transistor (6).

4. Circuit selon la revendication 3, caractérisé en outre par une deuxième diode (20) possédant une cathode couplée à ladite deuxième sortie et une anode couplée à la base dudit troisième transistor (8).

5. Circuit selon la revendication 4, où ledit premier étage push-pull est caractérisé par:

un quatrième transistor (10) possédant une base couplée au collecteur dudit troisième transistor (8), un collecteur couplé à ladite première source (66) de tension d'alimentation électrique, et possédant un émetteur;

un cinquième transistor (12) possédant une base couplée à l'émetteur dudit quatrième transistor (10), un collecteur couplé à ladite première source (66) de tension d'alimentation électrique, et un émetteur couplé à ladite première sortie (68); et

un sixième transistor (14) possédant une base couplée à l'émetteur dudit troisième transistor (8), un émetteur couplé à ladite deuxième source (la terre) de tension d'alimentation électrique et un collecteur couplé à ladite première sortie (68).

