

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN LINE DRIVER CIRCUITS

(71) We, THE PLESSEY COMPANY LIMITED, a British Company of Vicarage Lane, Ilford, Essex IG1 4AQ, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates to improvements in line driver circuits for use in digital line transmission systems.

The invention finds application in transmission systems using High Density Bipolar Number 3/Alternate Mark Inversion HDB3/AMI type transmission. Details of HDB3 type coding can be found in Communication Networks for Computers by D.W. Davies and D.L.A. Barber published by John Wiley & Sons, on pages 170 and 171.

Known line driver circuits consume in the order of 120mA and often incur 50% mismatch conditions because of incompatible transformer loadings under signal and no signal line states.

Accordingly an aim of the present invention is to provide an improved line driver circuit consuming less power than known circuits and which does not suffer from mismatch conditions.

According to the present invention there is provided a line driver circuit for use in digital line transmission systems, the circuit being transformer coupled to the line, the transformer having a centre-tapped primary winding and a secondary winding; the circuit comprising a first signal controlled switching device connected to one side of the primary winding, a second signal controlled switching device connected to the opposite side of the primary winding and a signal damping network connected across the primary winding and arranged to operate in such a manner than when the first and second switching devices are idle no signal appears in the secondary winding and damping network presents a load to the primary winding to balance the primary winding with the loading of the secondary winding, whereas when the first switching device is activated a first damping network

isolation device is activated and a first output signal is produced in the secondary winding and when the second switching device is activated a second damping network isolation device is activated and a second output signal of opposite polarity is produced in the secondary winding.

An exemplary embodiment of the invention will be described with reference to the accompanying drawing in which Figure 1 shows a line drive circuit according to the invention and Figure 2 shows various waveforms which occur at different points in the circuit shown in Figure 1.

Referring to Figures 1 and 2 waveform WFA is presented to the base of transistor TR1 by way of resistor R6 and waveform WFB is presented to the base of transistor TR2 by way of resistor R7. The digital line output signal shown as waveform DLO will be produced at the output of transformer T1 designated DLO in accordance with the following truth table:

WFA	WFB	DLO
H	L	+
L	H	-
L	L	0

All other states are inhibited

A logic '1' is transmitted down the line when DLO is + or - and a logic '0' is transmitted when DLO is 0.

When a logic '0' is to be transmitted to the line both transistor TR1 and TR2 are switched off by their respective WFA and WFB waveform being in the Low (L) state. Accordingly zero voltage appear across points X and Y, the centre-tapped primary winding of the transformer T1. Equal current flows through resistor R3 and R4 diodes D3 and D4 and resistor R5 of the damping network, causing diodes D3 and D4 to conduct. Diodes D3 and D4 remain in conduction for small variations in the transformer windings allowing overshoot and line reflections to be absorbed reducing the amount of crosstalk experienced. The amount of current allowed to flow through resistors R3 and R4 is limited by resistor R5

and the value of this is optimised for lowest possible current, consistent with an adequate level of damping. When current flows through resistors R3 and R4 the resistors are effectively connected across the primary winding and their values are such that they present a load of $4 \times R1$ across the centre-tapped primary winding of transformer T1. The transformer windings are, therefore, correctly matched and mismatch conditions are prevented from occurring.

When a logic '1' is to be transmitted to the line either transistor TR1 or TR2 is made to conduct by either waveform WFA or waveform WFB going to the high (H) state and accordingly either diode D3 or D4 is biased off. Resistors R3 and R4 are no longer in series across the centre-tapped primary winding of transformer T1 and therefore the damping circuit is not active. An increased amount of current will pass through resistor R5 and the conducting resistor-diode combination, either resistor R3 and diode D3 or resistor R4 and diode D4 causing a slight loss of power.

Resistors R1 and R2 are provided as line matching loads for transistors TR1 and TR2 respectively and diodes D1 and D2 shunt the respective collectors of transistors TR1 and TR2 respectively to earth for surge protection. Resistors R6 and R7 are in the order of 1Kohms and allow the circuit to be driven from low power schottky transistor-transistor logic.

The above description has been of one embodiment only and is not intended to limit the scope of the invention. Alternative arrangements will readily be seen by those skilled in the art, for example the value of resistor R5 can be varied to alter the damping threshold. The line driver circuit can be used in pulse code modulated systems.

45 WHAT WE CLAIM IS:—

1. A line driver circuit for use in digital line transmission systems, the circuit being

transformer coupled to the line, the transformer having a centre-tapped primary winding and a secondary winding; the circuit comprising a first signal controlled switching device connected to one side of the primary winding, a second signal controlled switching device connected to the opposite side of the primary winding and a signal damping network connected across the primary winding and arranged to operate in such a manner that when the first and second switching devices are idle no signal appears in the secondary winding and the damping network presents a load to the primary winding to balance the primary winding with the loading of the secondary winding, whereas when the first switching device is activated a first damping network isolation device is activated and a first output signal is produced in the secondary winding and when the second switching device is activated a second damping network isolation device is activated and a second output signal of opposite polarity is produced in the secondary winding.

2. A line driver circuit according to claim 1 in which the first and second signal controlled switching devices are transistors.

3. A line driver circuit according to claim 1 or 2 in which the first and second damping network isolation devices are diodes.

4. A line driver circuit according to claim 2 in which each transistor has an associated diode connected across their respective collector and base to provide surge protection for the transistors.

5. A line driver circuit as claimed in claim 3 in which the diodes have their positive end commoned and connected to earth by way of a resistor the resistance value of which determines the threshold of the damping network.

6. A line driver circuit substantially as described herein with reference to the accompanying drawing.

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