CALIBRATED GENERATOR GE4/529

Introduction

The GE4/529 produces an 8·6-kHz square-wave with a stable and accurate amplitude of either 1·0 volt p-p or 0·7 volt p-p as an operational standard of signal amplitude for use with oscilloscopes, waveform monitors and other signal-level measuring equipment. It can also produce a video test waveform comprising sync pulses 0·3 volt p-p in amplitude with or without a 0·7-volt p-p white-level bar. These are shown in Fig. 1. The video waveform is triggered by inputs of mixed sync pulses and mixed blanking pulses on any line standard.

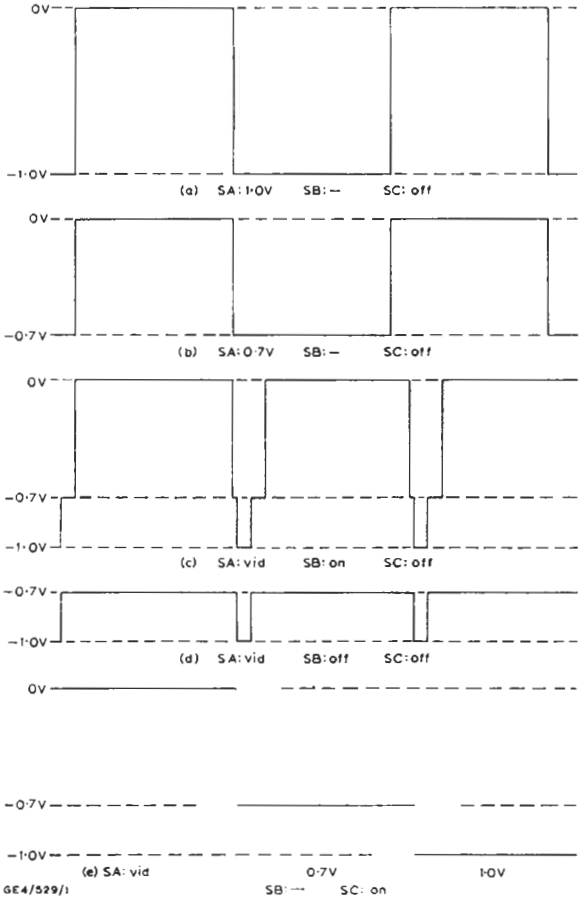

Fig. 1 GE4/529: Output Waveform

For calibration purposes the GE4/529 also produces d.c. outputs at exactly 1·0 volt and 0·7 volt.

The GE4/529 is self-powered but can be fed with an unregulated supply of 14 to 26 volts d.c. The unit switches itself off after about 4 minutes.

The GE4/529 is constructed on a CH1/26A chassis with index-peg positions 5 and 34.

General Specification

Trigger input impedance	high
Output impedance	75 ohms ±0·5 per cent.
Accuracy d.c. and normal square-wave outputs terminated in exactly 75 ohms at 20°C after line-up	±2 mV.
Stability with temperature	less than 1 mV per 10 degrees C.
Stability with time	less than 1 mV per month.
Stability with input voltage	less than 1 mV per 10 volts change.

Operation

There are two front-panel controls: a centre-biased *On-off* switch SB and a three-position switch SA with the positions labelled *1·0 volt*, *0·7 volt* (both square-wave) and *Video*. In addition there is a *Test* switch SC within the unit.

The GE4/529 is switched on by momentarily turning switch SB to the *On* position. It is turned off by momentarily turning switch SB to the off position. The unit also turns itself off after about 4 minutes.

8·6-kHz square-waves of either 1·0 volt p-p or 0·7 volt p-p amplitude are obtained with switch SA in its first two positions. The video output comprises a 0·7-volt p-p white level bar with 0·3-volt p-p sync pulses. The bar can be turned off, leaving just sync pulses, by holding switch SB in

the *On* position or by connecting pins 12 and 13 at the rear of the unit.

With switch SC in the *Test* position and any input pulses removed d.c. outputs are obtained: 1·0 volt, 0·7 volt or, in the *Video* position of switch SA, 0 volt. These d.c. outputs enable a routine check of the accuracy of the GE4/529 to be carried out.

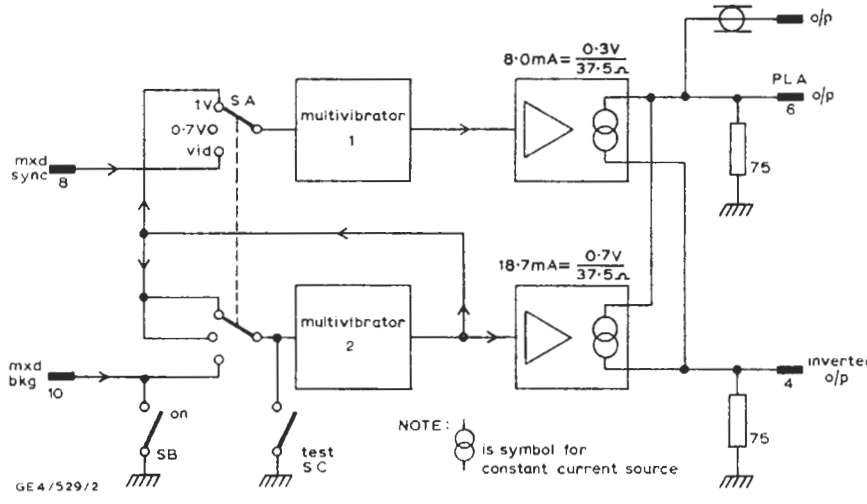

Fig. 2 Simplified Block Diagram of the GE4/529

General Description

A simplified block diagram of the GE4/529 is shown in Fig. 2. Two multivibrators each feed a constant-current output amplifier whose outputs are combined. The first of these amplifiers produces both normal and inverted pulses precisely 0·3 volt p-p in amplitude across parallel combinations of internal and external 75-ohm loads. The second amplifier produces similar pulses precisely 0·7 volt p-p in amplitude.

In the 1·0-volt and 0·7-volt positions of switch SA, the second multivibrator is connected as an astable circuit free-running at about 8·6 kHz. In the 1·0-volt position of switch SA the first multivibrator is driven from the second so that the outputs of their respective constant current amplifiers combine to give an output precisely 1·0 volt p-p in amplitude across an exact 75-ohm external load.

In the *Video* position of switch SA the first multivibrator is driven by mixed sync pulses and the second multivibrator is driven by mixed blanking pulses. The outputs combine to produce a 0·7-volt white level bar and 0·3-volt sync pulses. There is also a facility by which holding switch SB in the *On* position effectively short circuits the mixed blanking pulses. This produces a feed of mixed sync pulses with no bar.

In the 1·0-volt and 0·7-volt positions of switch SA, operation of switch SC stops the astable action of the second multivibrator. This produces 1·0 volt and 0·7 volt d.c. outputs which can be checked on a digital voltmeter.

Circuit Description

The circuit diagram of the GE4/529 is given in Fig. 3 on page 3. Input sync pulses are inverted by transistor TR1 whose output amplitude is limited to 0·8 volt p-p. These positive-going sync pulses are differentiated and fed via switch SA-2 to the reset input of the bistable crcuit IC1. The input sync pulses are also differentiated and fed via switch SA-1 to the set input of bistable circuit IC1.

The mixed blanking input circuit is similar with the additions of shorting switch SB-2 between pins 12 and 13 and a *Test* switch SC. Switch SB-2 changes the bias of the direct mixed-blanking feed to the set input of bistable circuit IC2, thus inhibiting this input and permitting the bistable to be switched only to the reset state. This state of IC2 corresponds to there being no white level bar. Switch SC inhibits IC2 maintaining it in the reset state (*1·0-volt* or *0·7-volt* positions of switch

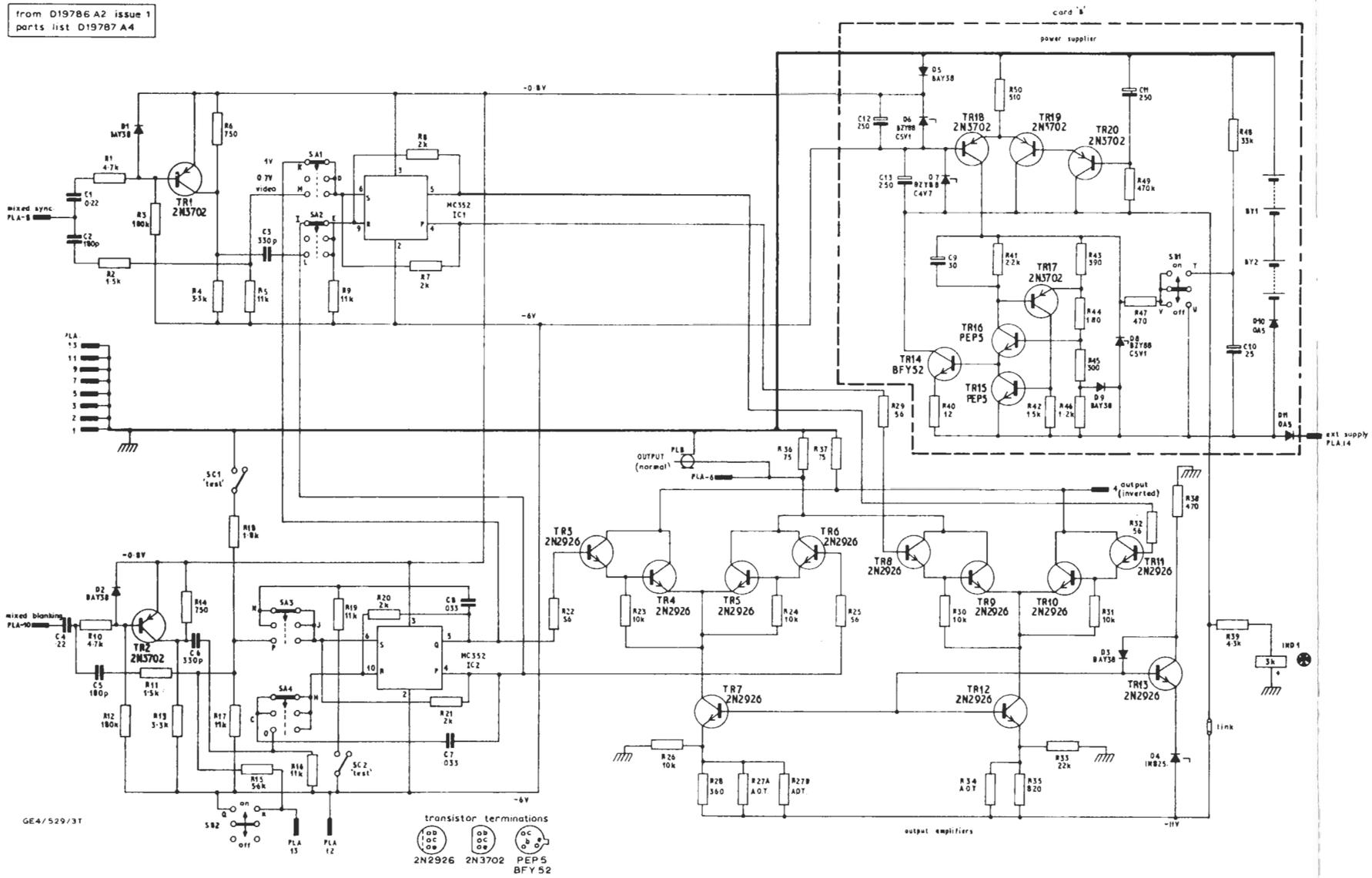

Fig. 3 Circuit of the GE4/529

SA) or in the set state (*Video* position of switch SA).

The output amplifiers comprise two Darlington long-tailed pair amplifiers fed from constant current sources. The base voltage of transistors TR7, TR12 and TR13 is the breakdown voltage of zener diode D4 plus the base-emitter voltage of transistor TR13. The base-emitter voltages of these three transistors vary in the same way over a wide temperature range. This compensates for temperature changes because their emitter voltages are equal to the voltage across the zener diode D4.

The emitter resistor networks are adjusted to supply current to a standard 75-ohm load so that the output voltages are precisely 0·7 volt and 0·3 volt from the two amplifiers. Resistors R26 and R33 provide compensation for small errors arising from possible changes of voltage in the −11 volt supply.

Resistors R23, R24, R30 and R31 prevent charge storage effects affecting the output waveforms.

The monostable power supply shown inside the dotted line on the circuit diagram operates either on its internal battery or from an external supply. Diodes D10 and D11 provide automatic isolation between alternative supplies.

The derivation of the power supply circuit is shown in Fig 4. The circuit shown in Fig. 4(a) is a simple series-stabilised circuit with no feedback. In this circuit the zener-diode feed resistor is connected to the unstabilised input and so the zener diode current varies with the input voltage. Instead of the more usual arrangement of feeding the zener diode from the stabilised output of the circuit, Fig. 4(b) shows the zener diode fed from a constant-current source which in turn is stabilised by a zener diode.

The same circuit is redrawn in Fig. 4(c) to show its symmetry and in Fig. 4(d) it is rearranged so that each zener diode is stabilising the current feed to the other. The component references correspond to those in Fig. 3. The load in Fig. 4(d) is taken from across the zener diode instead of, as is more usual, from the emitter. This circuit is bistable. If neither transistor is conducting there is no bias and so the circuit is stable in its off condition as well as in its on condition.

The circuit given in Fig. 4(e) includes a switch used to trigger the circuit on and off. Capacitor C10 is charged to the input voltage. Momentarily making the *On* contact of switch SB-1 permits capacitor C10 to discharge through diode D8 thereby turning on the circuit. Momentarily making the *Off* contact short circuits diode D8 thereby turning off the circuit. Diodes D5 and D7 are included to provide outputs at different voltages.

The circuit shown in Fig. 4(f) includes the basic components of an automatic turn-off circuit. With the stabilised supply circuit on, capacitor C11 charges via resistor R49. The emitter potential of transistor TR19 is determined by the current taken by transistor TR18 and the value of resistor R50. If the base potential of transistor TR19 is more negative than the emitter potential, this transistor conducts, decreasing the current available for transistor TR18. This shuts off the circuit automatically.

Transistor TR16 is an emitter follower feeding the output transistor TR14. Diode D9 provides temperature compensation for the base-emitter junction of transistor TR16. With the stabilised supply switched off, however, there can be a small leakage current flowing through diode D9 and at such a low current the impedance of the diode is high. Resistor R34 therefore prevents the stabilised supply from turning itself on due to this leakage current in diode D9.

In the complete circuit given in Fig. 3 transistors TR19 and TR20 are connected as a Darlington pair to reduce the base current required in transistor TR20 to shut off the circuit.

The circuit also shuts off automatically if the input voltage is too low. A decrease in the input voltage is taken up by a corresponding decrease in the emitter-collector voltage of transistor TR14. As this voltage falls below about 1 volt, the base current starts to rise appreciably. This increase in base current increases the voltage drop across resistor R41 causing transistor TR17 to conduct as its base potential becomes negative with respect to its emitter. The collector current of transistor TR17 turns on transistor TR15 which increases still further the current through resistor R41 thereby shutting off the stabilised power supply circuit.

Routine Test

The GE4/529 should be checked for accuracy about once every three months. If the apparatus required is not available, the unit should be returned to Equipment Department for checking.

Apparatus Required

Solartron Digital Voltmeter Type LM1420.
75-ohm standard termination (±0·1 per cent or better).
Thermometer.

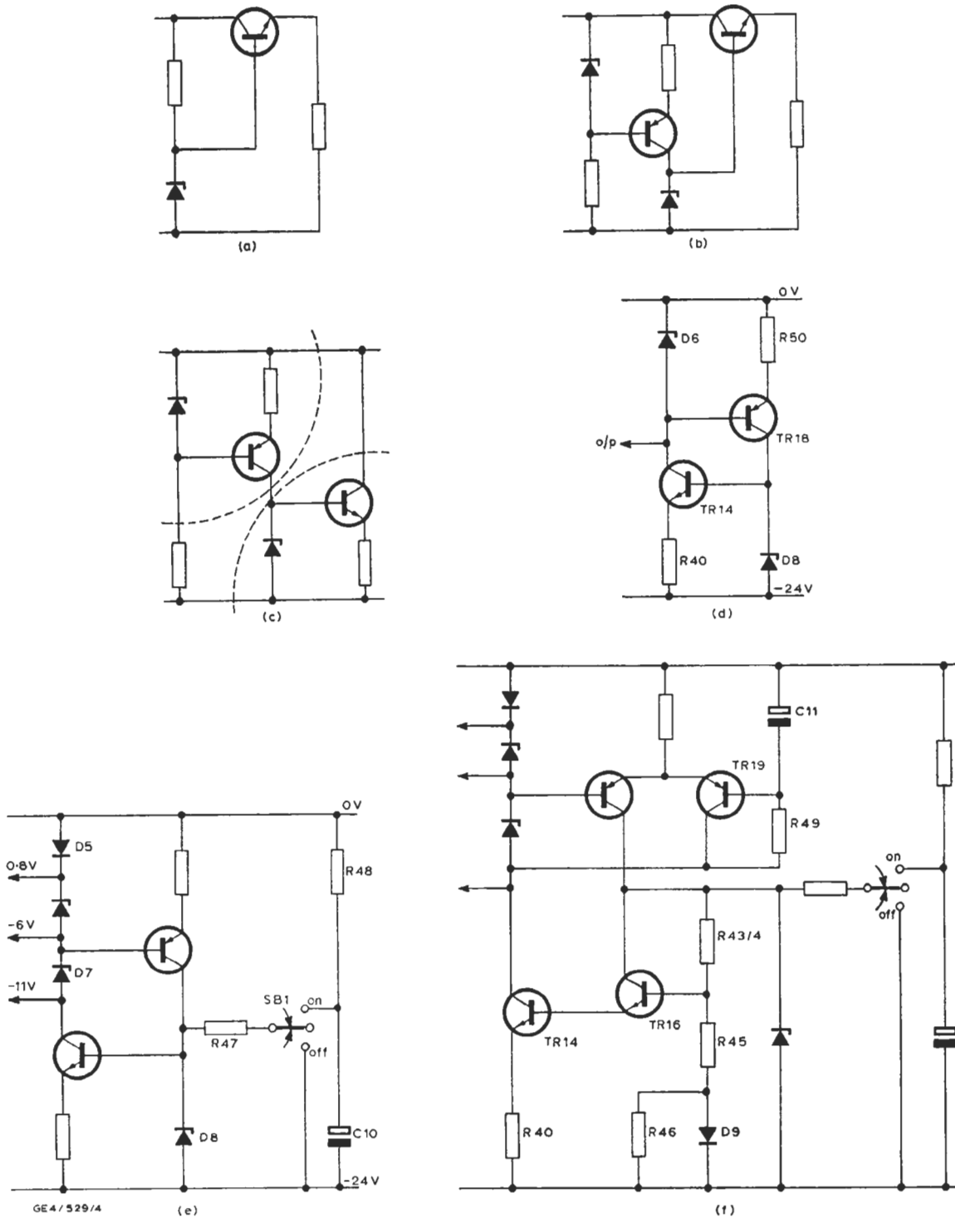

Fig. 4 Derivation of the Power-supply Circuit