COUNTER DRIVE PULSE GENERATOR GE2/542

Introduction

The GE2/542 forms part of a telecine equipment[1,2]. It is driven by pulses derived from two permanent magnets which are attached to the main drive shaft of the equipment; it provides a pulse signal, which drives a film-counter, and a d.c. signal which indicates the direction of rotation of the main drive shaft.

The generator is divided into two units: the pick-up unit (Unit 1) which produces two pairs of pulses for each rotation of the main drive shaft, and the processing unit (Unit 2) which processes these pulses to produce the two output signals. Unit 1 is constructed on a printed-wiring board about 65 mm (2·5 in) square and mounted adjacent to the main drive shaft. Unit 2 is constructed on a CH1/12A chassis with index-peg positions 18 and 30.

General Specification

Unit 1 (Pick-up Unit)

Maximum spacing between pick-up head and magnet	1·5 mm
Maximum speed of magnet past pick-up head	20 metres/sec
Maximum speed of counting	164 counts/sec (82 frames/sec)
Type of magnet	Eclipse Button Magnet Cat. No. 821A
Power Requirements	12 V at 7 mA

Unit 2 (Processing Unit)

Inputs	2 overlapping pulses per half frame from Unit 1.
Outputs (d.c.)	2 sets of relay changeover contacts operated according to the direction of rotation of the magnet.
Output (pulse)	2 V p-p, negative-going about 1 ms in duration with the leading edge delayed by 5·6 ms with respect to the operation of the relay.
Power Requirements	12 V at 100 mA (when reverse running) 12 V at 50 mA (when forward running).

General Description

Pick-up coils L1 and L2 in Unit 1 have ferrite cores and each coil forms part of a parallel-tuned circuit. The two circuits are tuned to 1 MHz and, in the absence of an external magnetic field, pass sinusoidal signals at that frequency. When a permanent magnet moves past one of the coils, the ferrite core becomes saturated and the coil inductance is temporarily reduced to about one tenth of its original value. Therefore, the resonance frequency of the tuned circuit rises and the signal is effectively short-circuited.

Because two pick-up coils are used, two pulses are produced by the movement of each magnet and so the direction of rotation can be detected. The two pulses have an overlapping time relationship and are processed in Unit 2 to form:

(a) a single trigger pulse for each passage of each magnet;

(b) a relay-operating signal which is dependent on the direction of magnet rotation.

Note that there are two magnets on the main drive shaft and so the pulses described above are produced twice per drive-shaft revolution.

Circuit Description

The circuit is shown in Fig. 1 and the waveforms present at various points in the circuit are given in Fig. 2.

Unit 1

The output from transistor TR1, which functions as a 1-MHz oscillator, is applied via emitter follower TR2 to two parallel-tuned circuits comprising L1,C7 and L2,C9. The signals developed across the tuned circuits are fed to detector circuits and potentials of about −2 volts are produced at output pins B and M. When one of the magnets which are mounted on the main drive shaft sweeps past L1 and L2 the coil inductances are momentarily reduced; consequently the signals developed across the tuned circuits are reduced to a very low level and the output potentials fall almost to zero volts. As the magnet moves away from the pick-up coils, the inductances return to normal and the output potentials increase to −2 volts again. Thus a pulse is developed at each of the outputs for each passage of the magnet. One pulse is slightly in advance of the other and the pulse durations overlap.

Unit 2

The pulse applied to PLA 4 drives transistor TR1 into cut-off and the output from TR1 feeds a Schmitt trigger circuit formed by TR2 and TR3; the Schmitt trigger operates when the collector potential of TR1 reaches about −3 volts. From the Schmitt trigger the signal is applied to emitter-follower TR4 and the signal developed at the junction of the emitter-load resistors R10 and R11 consists of a negative-going pulse with sharp transitions and a peak-to-peak amplitude of about 3·8 volts. This pulse is fed to transistors TR13 and TR14.

The pulse applied to PLA 5 drives transistor TR8 into cut-off and operates the Schmitt trigger circuit formed by TR6 and TR7. The Schmitt trigger output feeds phase-splitter TR5 and the pulses developed at the collector and emitter of this stage are differentiated and fed to the bases of TR14 and TR13 respectively.

Transistors TR13 and TR14 form a direction-sensing stage and when there are no input pulses applied to the unit both transistors are reverse-biased by about 4·8 volts. The negative-going pulse developed at the emitter of TR4 reduces the reverse bias on TR13 and TR14 to about 1 volt, whereupon the negative-going spikes from the differentiated outputs of TR5 will drive either TR13 or TR14 into conduction.

When the magnets rotate in one direction, the bias on TR13 and TR14 will be reduced before the arrival of the differentiated pulses. When this happens the spike derived from the leading edge of the negative-going pulse at the emitter of TR5 will drive TR14 into conduction. By the time that a negative-going spike has been applied to TR13, the emitter of TR4 has returned to normal and the reverse bias on TR13 has increased. When the magnets rotate in the other direction, the reverse bias on TR13 and TR14 will be reduced only just before the spike derived from the trailing edge of the positive-going pulse developed at the collector of TR5 is applied to TR13, and TR13 will conduct. Thus the direction of travel of the magnets determines whether TR13 conducts or TR14 conducts.

The outputs from TR13 and TR14 are fed to either side of a bistable multivibrator comprising TR11 and TR12; thus the state of the bistable circuit depends on whether TR13 or TR14 conducts. The bistable output operates relay RLA via emitter followers TR9 and TR10. The changeover contacts of the relay are used to set the direction of counting of an external indicator.

The other outputs from TR13 and TR14 are added together through diodes D3 and D4 and used to trigger a delay monostable multivibrator formed by transistors TR15 and TR16. The output from TR15 drives a further monostable stage formed by TR17 and TR18; a negative-going pulse with a duration of 1 millisecond is developed at the collector of TR17. This pulse feeds emitter-followers TR19 and TR20 to provide two counting-pulse outputs, at PLA 14 and PLA 15, which are about 2 volts peak-to-peak in amplitude and are negative-going from zero volts. The delay in the counting-pulse circuit ensures that the relay in the direction-sensing circuit has time to energise or de-energise before the counting pulse is applied to the counter; the presence of this delay limits the maximum frequency at which pulses can be produced.

Maintenance

Unit 1

The waveform at the base of TR2 should have an amplitude of 10 volts peak-to-peak (±10 per cent), a frequency of about 1 MHz and should be approximately sinusoidal in shape. To tune the oscillator, connect an Avometer Model 8 or a high-impedance oscilloscope to pin B or to pin M. Check that the magnet is well away from the pick-up head and adjust the core of T1 for maximum negative output (about −2 volts). Check that the output voltage drops to less than −0·3 volts when the magnet is close to the pick-up head.

The recommended working gap between the pick-up head and the magnet is 0·8 mm (1/32in.)

Typical d.c. voltages at the transistor electrodes as measured with a Model 8 Avometer are given in Table 1. All voltages are negative with respect to zero volts.

TABLE 1

Transistor	*Collector*	*Base*	*Emitter*
TR1	12	3·2	3·0
TR2	12	6·0	5·8

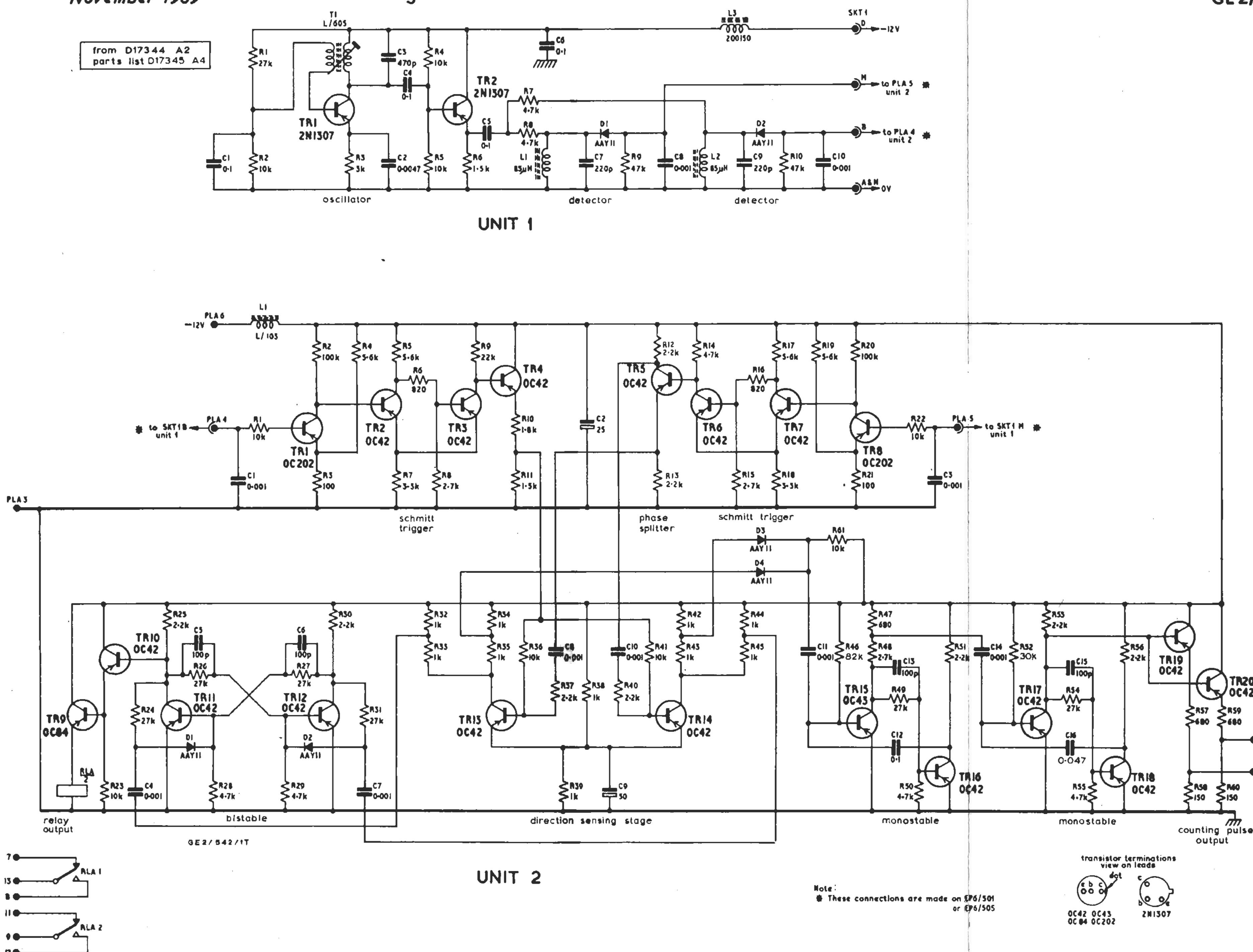
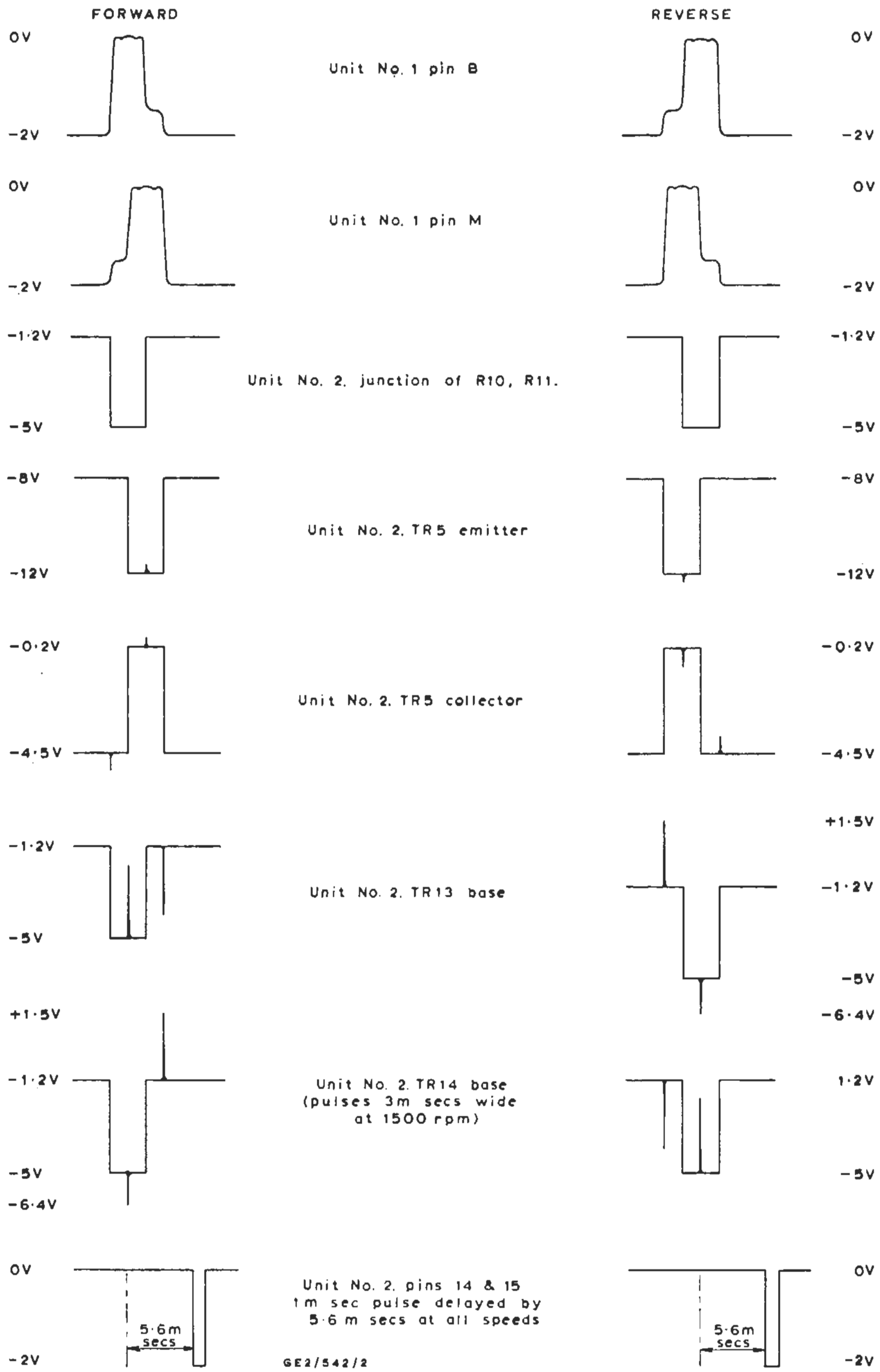


Fig 1 Circuit of the Counter Drive-pulse Generator GE2/542



GE2/542 *Fig 2 Waveforms in the Counter Drive-pulse Generator GE2/542*

Unit 2

Typical d.c. voltages at the transistor electrodes for the *No Magnet/Magnet Present* conditions are given in Table 2 and typical d.c voltages for the *Forward/Reverse* conditions are given in Table 3. All voltages are negative with respect to zero volts. The sign — indicates a direct connection to a previously measured point.

TABLE 2

Transistor	*No Magnet*			*Magnet Present*		
	Collector	*Base*	*Emitter*	*Collector*	*Base*	*Emitter*
TR1/TR8	0·25	0·75	0·23	3·0	0	0·2
TR2/TR7	3·9	—	2·55	2·85	—	2·8
TR3/TR6	2·55	2·2	—	10·7	2·8	—
TR4	12·0	—	2·5	12·0	—	10·9
TR5	4·25	7·4	7·5	0	12·0	12·0
TR13/TR14	12·0	1·1	6·1	12·0	4·7	6·1
TR15/TR17	0	0·2	0	*Not applicable.*		
TR16/TR18	12·0	0	0			
TR19/TR20	12·0	0·03	0			

TABLE 3

Transistor	*Forward*			*Reverse*		
	Collector	*Base*	*Emitter*	*Collector*	*Base*	*Emitter*
TR9	12·0	0	0	12·0	10·85	10·8
TR10	12·0	0	—	12·0	11·1	—
TR11	—	0·25	0	—	0·03	0
TR12	11·1	0·02	0	0	0·25	0

References

1. Vidicon Telecine EP6/501, D.D. Tech. Mem. 7.133(67)

2. Colour Telecine Equipment EP6/505