

MOTOR DRIVE AMPLIFIER AM1/536

Introduction

The AM1/536 provides a feed for the rotor windings of a synchronous-type motor which enables it to run locked to station field pulses while the stator is energised from a 50-Hz supply. The amplifier accepts a three-phase mains feed and a feed of field-trigger pulses; from these inputs it derives a signal at the difference frequency between field-pulses and mains which, after power amplification, is applied to the rotor of the associated motor.

The AM1/536 consists of four plug-in sub-units, three Unit-1 Drive Amplifiers and one Unit-2 Power Supplier and Synchroscope. These units are mounted, together with a three-phase mains transformer, on a PN3/23 chassis. A diagram which shows the wiring of the parent unit is given in Fig. 1.

General Specification

Inputs

Mains	220 or 230 volts, 50Hz, 3-phase
Field trigger pulses	2 volts p-p

Output three-phase ± 15 volts
into a 15-ohm load

Operating Temperature Range 20°C to 45°C

Frequency Range 50 Hz ± 4 Hz

Chassis

Unit 1	CH1/12A
Unit 2	CH1/12B

Index Peg Positions

Unit 1	10 and 19
Unit 2	10 and 21

Circuit Description

Unit 1

The circuit of a Unit-1 Drive Amplifier is given in Fig. 2. Field-drive pulses are applied via emitter-follower TR1 and transformer T1 to transistors TR2 and TR3. The transformer is connected so that the pulses at the bases of TR2 and TR3 are positive-going; the transistors conduct

for the duration of each pulse and sample the 30-volt peak-to-peak sine waveform which is present at the collector of TR2. The sampled voltage is stored in capacitors C3 and C4 and can vary both in amplitude and polarity, the variation depending on the phase relationship between the sine waveform and the field-trigger pulses. Because polarity of the sampled voltage can reverse, two electrolytic capacitors are used for storage so that the correct polarity is preserved on each capacitor at all times. Ideally, the stored voltage should remain constant between the sampling periods, but in practice the capacitors discharge slowly towards earth via the input impedance of the output amplifier.

The stored voltage is applied via the complementary driver stage TR4, TR5 to the push-pull output stage TR6, TR7. Diodes D3 to D6 provide a small potential difference between the bases of the driver transistors; this causes a small standing current to flow in the output stage and so prevents cross-over distortion.

Unit 2

The Unit-2 circuit is shown in Fig. 3. The signals from the three Unit-1 amplifiers are limited in amplitude to ± 20 volts by diodes D13 to D18 and are then applied via chokes L1 to L3 to the rotor windings of the associated synchronous motor. The chokes prevent any pulses from the rotors passing back into the output stages of the amplifiers and damaging the transistors. For further protection the outputs are fused.

An indication of any frequency variations between the mains and field-trigger input signals is provided by a IN3/502 Synchroscope. This device consists of six bulbs which are connected via diodes between the three outputs and earth. (The earth potential is derived from the ± 20 -volt supply via zener diodes D31 to D34). For unlocked pulses, as the three outputs vary between ± 15 volts, each lamp in turn slowly increases to full brilliance and then dies down again. When the system is not locked the indication rotates at the frequency difference between pulse and mains frequencies; it moves in a clockwise direction when pulses are faster than mains. When the system is locked the indication is stationary and which of the lamps remains alight depends on the relative phasing of

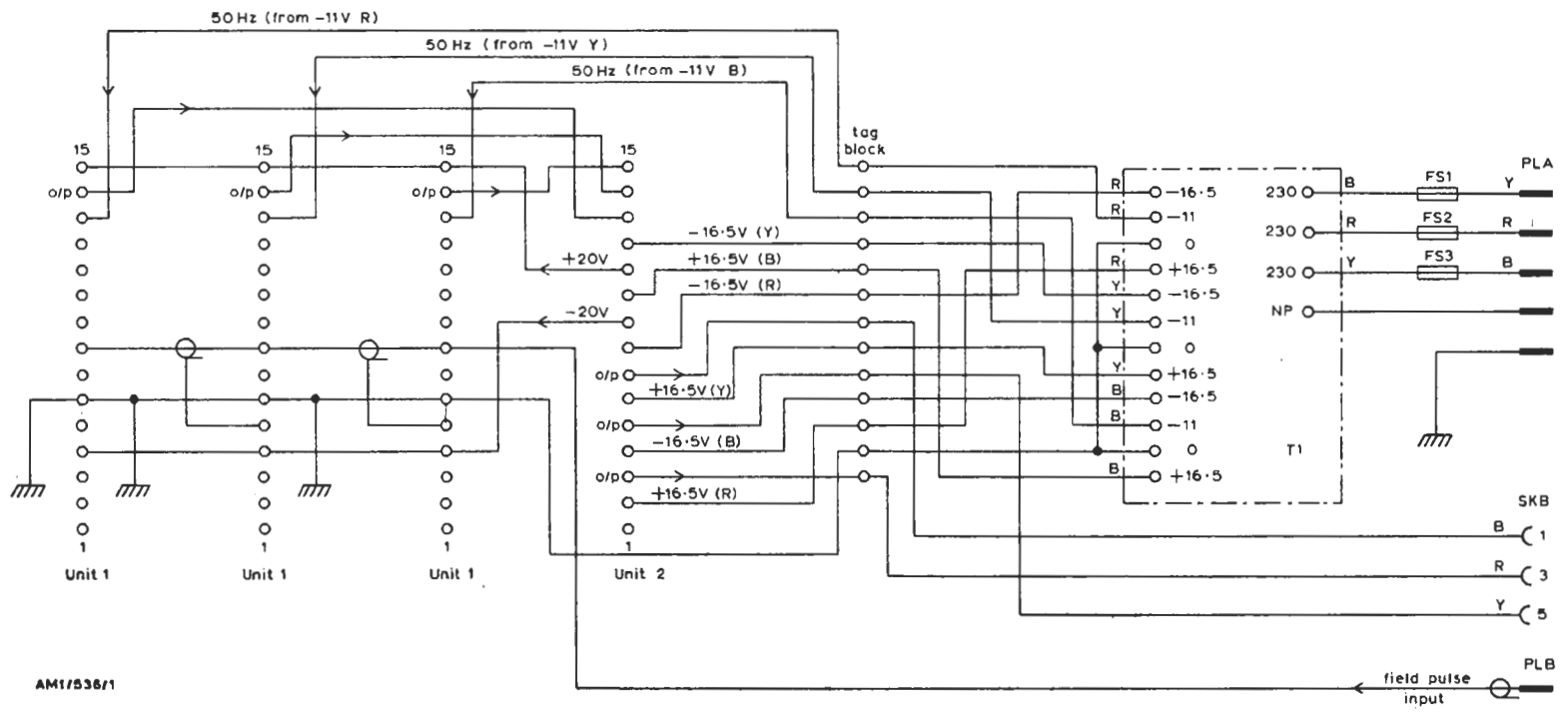
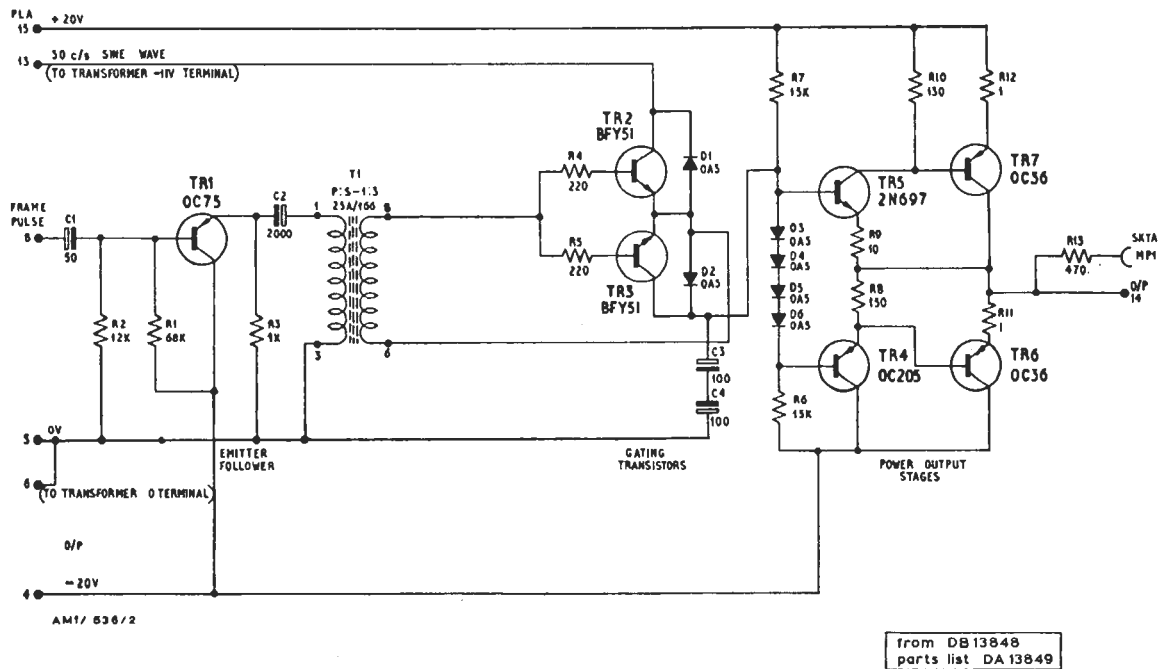


Fig. 1 Wiring of the Motor-drive Amplifier AM1/536

AM1/536/1



TRANSISTOR TERMINATIONS
VIEW ON LEADS

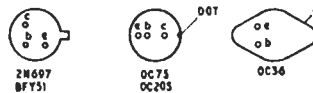


Fig. 2 Circuit of Unit 1 in the AM1/536

the mains input and the field-trigger pulses.

Unit 2 contains also a three-phase full-wave rectifier circuit which produces three ± 20 volt supplies from the 16.5-volt outputs of the three-phase transformer. These voltages are used to power the associated Unit 1-drive amplifier.

Maintenance

The voltage at the emitter of TR1 in the Unit-1 amplifiers is about -3 volts and the base of TR1 is about 0.25 volts more negative than this. Other voltages throughout the circuit depend on the

relative phase of the sampling pulses and the 50-Hz signal applied to transistors TR2 and TR3.

Fault finding is best carried out with an oscilloscope using the waveforms shown in Fig. 4 as a guide. Waveforms 4(d) and 4(f) show the output in the unlocked condition. In 4(d) the frequency difference is about 0.2 Hz and the sampling pulse can be seen at the cross-over point of the curve. In Fig. 4(f) the frequency difference is about 2 Hz and the effect of sampling can be seen more clearly.

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See overleaf for Fig. 3.

See page 5 for Fig. 4.

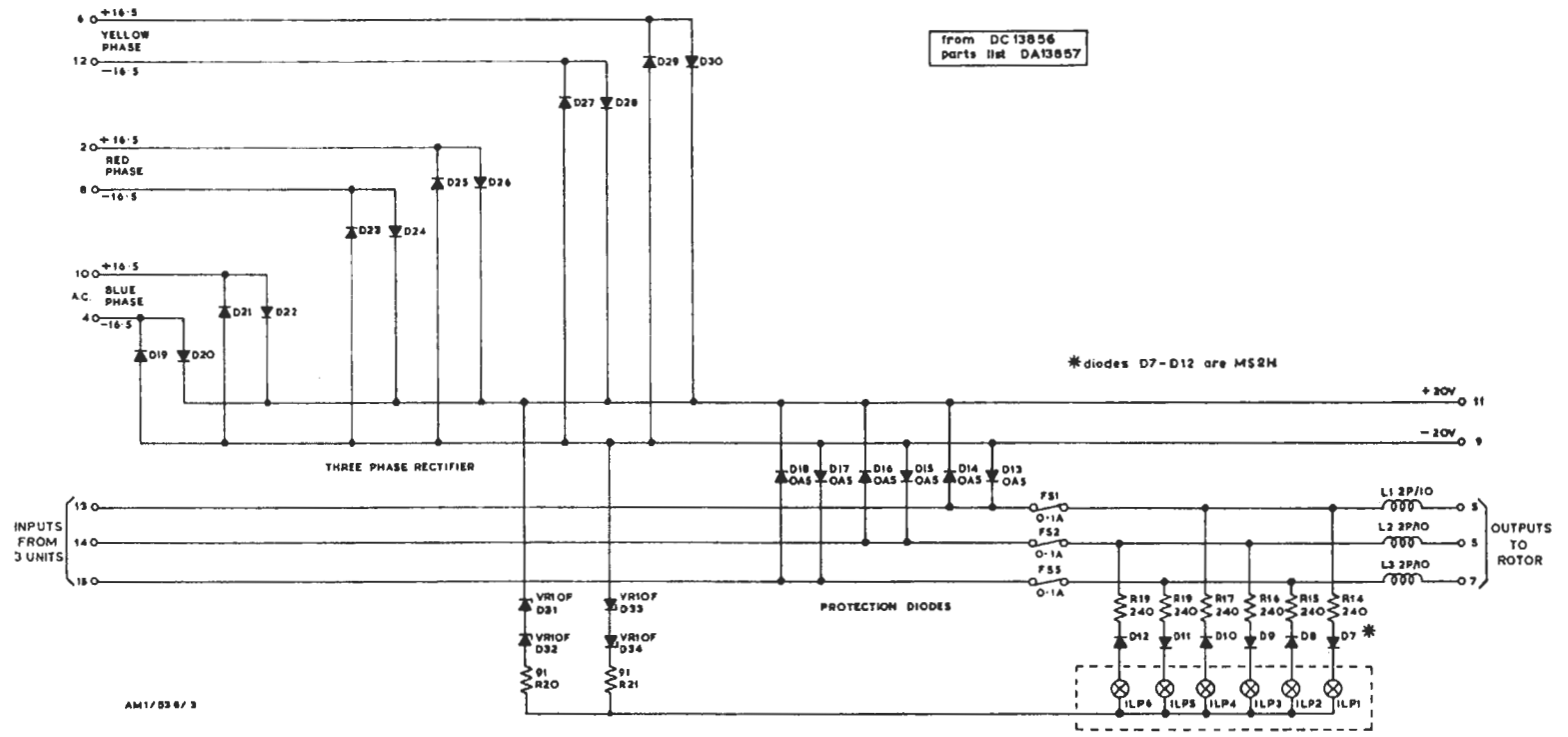
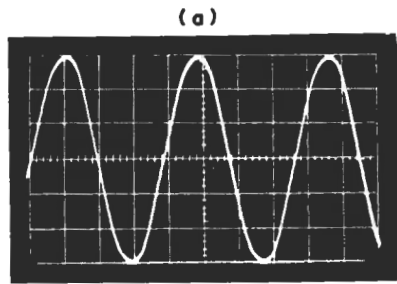
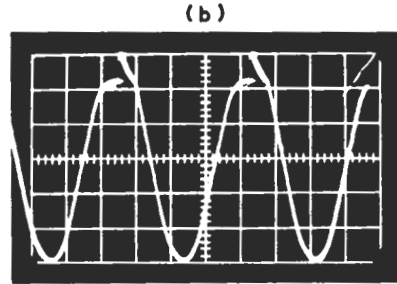


Fig. 3 Circuit of Unit 2 in the Motor-drive Amplifier AMI/536

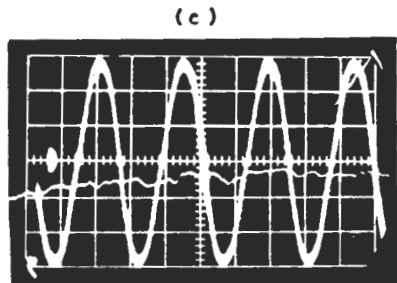


TR2 collector 5V/cm, 5ms/cm

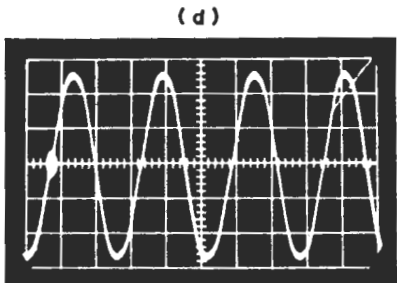
AM1/536/4



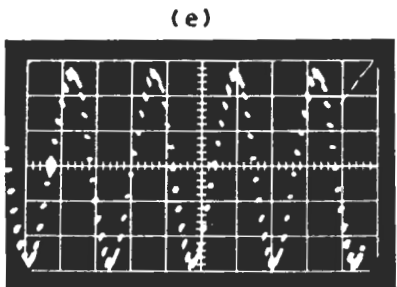
TR2 and TR3 emitters 5V/cm, 5ms/cm



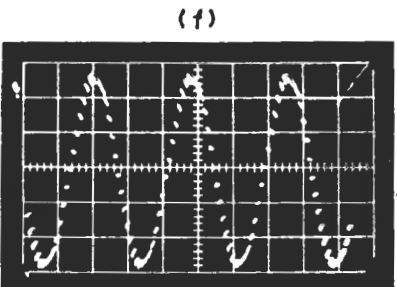
TR3 collector 5V/cm, 2sec/cm
(difference in mains and trigger frequencies 0.2 Hz)



Output to motor 5V/cm, 2sec/cm
(difference in mains and trigger frequencies 0.2 Hz)



TR3 collector 5V/cm, 0.2 sec/cm
(difference in mains and trigger frequencies 2 Hz)



Output to Motor 5V/cm, 0.2 sec/cm
(difference in mains and trigger frequencies 2 Hz)

Fig. 4 Waveforms in the AM1/536