# SLAVE LOCK RECEIVING AMPLIFIER AM1/517

## General Description

The AM1/517 is a transistor amplifier used in remote slaving, a process by which video signals derived from different waveform generators can be made synchronous for mixing. The amplifier, together with a power supply PS1/1 and a modified chassis CH1/13B, forms a slavelock receiving unit UN1/533P. This unit is used at the *remote* (slaved) site and receives a twice-line frequency signal sent from a picture synchroniser unit UN1/522 or UN1/528 located at the *local* (slaving) site.

The AM1/517 accepts the twice-line frequency signal down to a level of −30 dBm, and will amplify, clip and integrate the signal, giving an output of 1 volt peak-to-peak into 75 ohms. Should the level of the incoming signal fall below −30 dBm, the output signal is automatically provided by an internal oscillator, whose frequency may be locked to that of an external crystal oscillator.

The twice-line frequency signal, incoming to the amplifier, is used to drive the waveform generator at the remote site, in such a way that the video signals from the remote site arrive correctly phased, both in line and picture, at the local site. The AM1/517 amplifier also indicates whether its own output is internally or externally derived.

The AM1/517 may be used on either the 405-line or 625-line standard, the change being effected by means of reversible plug-in boards. The amplifier is constructed on a CH1/12A chassis, with printed wiring, and requires a power supply giving 6·4 volts at 20 mA d.c. stabilised and 10 volts at 40 mA d.c. unstabilised.

## Circuit Description (Fig. 10)

The twice-line frequency signal is applied via a balanced input transformer L1. Capacitors C1, C3A and C3B are used to tune L1 to form a half-octave bandpass filter, which considerably reduces the effect of spurious signals and noise incoming on the link from the local site. The signal is then amplified by transistors TR1 and TR2, which form a Darlington or super-alpha pair.*

The amplified signal is fed via C5 to transistors TR3 and TR4, connected as a long-tailed pair, where it is clipped and then integrated by C10 and R8, which have a time constant of 20 μsec. This results in a triangular waveform, whose amplitude (about 2·8 volts) is independent of input signal level, provided that this is above about −30 dBm, but is dependent on frequency, i.e., on whether the 405-line or 625-line standard is being used.

This triangular waveform is fed to the output amplifier via resistors R20 and R21, which compensate for the change of level which the change of line standard would otherwise cause. Negative feedback is applied from the emitters of the complementary emitter-followers, TR8 and TR9, to the base of TR7, via the resistor R15 in parallel with capacitor C16; this reduces the output impedance and also gives a falling frequency response, which to a large extent removes the harmonics of the triangular waveform, giving (on pin 14) a nearly sinusoidal output of 1 volt peak-to-peak into 75 ohms from a 75-ohm source.

The signal appearing at the emitters of transistors TR3 and TR4 is also rectified by diode D1, using transistor TR5 as its load, and the current through this transistor operates relay RLA. If the input signal disappears, or falls below the level that gives satisfactory clipping, relay RLA releases. The output amplifier is then driven from a local oscillator, TR6, via resistors R22 and R23, which give the correct level of signal on the base of transistor TR7.

The oscillator is a modified Colpitts type with amplitude control and provision for external locking. The diodes, D2 and D3, rectify the alternating voltage across L2. When this voltage equals the supply voltage, the d.c. bias on transistor TR6 falls to zero, cutting off this transistor and thereby stabilising the output voltage of the oscillator at about 6·4 volts peak-to-peak.

A 1-volt peak-to-peak twice-line frequency signal from a precision crystal source can be injected via capacitor C19 onto the base of transistor TR6, to lock the oscillator should this be thought necessary.

The amplifier AM1/517 can be used on either the 405-line or 625-line standard as mentioned earlier, by reversing the plug-in boards A and B. These change the bandpass-filter centre frequency and the oscillator frequency, and adjust the level of the signal fed to the output amplifier.

*See *BBC Engineering Monograph* No. 26, August 1959; 'Transistor Amplifiers for Sound Broadcasting', by S. D. Berry.

**General Data**

| | |
|---|---|
| Size | Constructed on a CH1/12A chassis. |
| Power Supplies | 6·4 volts and 10 volts d.c. from a PS1/1. |
| Input | 0 to −30 dBm at either: 31,250 ±75 c/s or 20,250 ±50 c/s. |
| Output | 1 volt peak-to-peak at input frequency or, if input fails, at internal oscillator frequency. |

**Test Procedure**

*Apparatus Required*

Avometer Model 8.
6·4-volt 20-mA stabilised and 10-volt 40-mA unstabilised d.c. supplies (e.g., from PS1/1).
Wayne Kerr video oscillator Type 022B.
J. Langham Thompson electronic frequency meter Type 6010/7.
Tektronix oscilloscope Type 515.
82-ohm, 560-ohm and 75-ohm resistors.

*Setting Up*

1. Earth pin 7 and connect a 6-volt P.O. No. 2 signal lamp between pin 6 and a source of 6 volts (e.g., PS1/1 pin 4).
2. Terminate the output of the AM1/517 in 75 ohms and connect to the oscilloscope and frequency meter.
3. Terminate the output cable from the video oscillator in 82 ohms and connect the inner conductor to pin 3 of the AM1/517 with the 560-ohm resistor and the screen to pin 1. Also connect pin 2 to pin 1.
4. Connect the power supplies as follows:
   pin 1 earth
   pin 8 −6·4 volts
   pin 9 −10 volts

*Tests*

1. Unplug the video oscillator and connect the Avometer in the power-supply 6·4-volt lead. Check that the current drawn does not exceed 15 mA and that the signal lamp is not illuminated.
2. Ensure that both plug-in cards are inserted in the 625-line position.
3. Adjust L2 to make the output frequency 31,250 ±5 c/s. Measure the output voltage, which should be between 1·0 and 1·6 volts peak-to-peak. If necessary change R22 to bring the output within these limits. (Increasing R22 reduces the output.)
4. Replug the video oscillator and set its output level to 0 dB (1 volt peak-to-peak) and set the frequency to 31,250 ±10 c/s. The indicator lamp should now be illuminated. Measure the output voltage of the amplifier, which should be between 1·0 and 1·6 volts peak-to-peak. If necessary change R20 to bring the output within these limits. (Increasing R20 reduces the output.)
5. Measure the amplifier output for a 0-dB output from the video oscillator, and note the oscillator output levels at which the indicator-lamp extinguishes and relights. Repeat these tests at 20 kc/s and 45 kc/s. The results should fall within the following limits:

| *f* (*kc/s*) | *AM1/517 Output for 0-dB Osc. Output (volts peak-to-peak)* | *Oscillator Level (dB)* | |
|---|---|---|---|
| | | *Lamp Extinction* | *Lamp Operation* |
| 20 | 1·6—3·0 | −15 ±3 | −12 ±3 |
| 31·25 | 1·0—1·6 | −24 ±3 | −20 ±3 |
| 45 | 0·5—0·9 | −17 ±3 | −14 ±3 |

6. Reverse both plug-in cards so that they are in the 405-line position and remove the input.
7. Adjust the value of C14B on the plug-in card A to make the output frequency 20,250 ±5 c/s. (Increasing C14B reduces the frequency.) Measure the output voltage, which should be between 1·0 and 1·6 volts peak-to-peak. If necessary, change R23 to bring the output within these limits. (Increasing R23 reduces the output.)
8. Repeat operation (4), using 20,250 ±10 c/s instead of 31,250 c/s, and adjusting R21 instead of R20 to obtain the output voltage required.
9. Measure the amplifier output for 0 dB output from the video oscillator and note the oscillator output level at which the indicator-lamp extinguishes and relights. Repeat these tests at 15 kc/s and 30 kc/s. The results should fall

within the following limits:

| *f* (*kc/s*) | *AM1/517 Output for 0-dB Osc. Output (volts peak-to-peak)* | *Oscillator Level (dB)* | |
|---|---|---|---|
| | | *Lamp Extinction* | *Lamp Operation* |
| 15 | 1·6—3·0 | −12 ±3 | −8 ±3 |
| 20·25 | 1·0—1·6 | −22 ±3 | −19 ±3 |
| 30 | 0·5—0·9 | −16 ±3 | −12 ±3 |

10. Reduce the output level of the video oscillator to −40 dB, reset the frequency to 20·25 kc/s and measure the signal voltage on the collector of transistor TR4. This should be between 0·4 and 0·8 volt peak-to-peak. Remove the earth connection between pins 1 and 2 and increase the output level of the video oscillator until the same voltage appears on the collector of transistor TR4. The output of the video oscillator should now be not less than +4 dB.

**General Maintenance**

Similar precautions to those described for amplifier AM4/505 should be taken if it becomes necessary to replace a transistor or any other component. A table of typical voltages at transistor terminals with no signal input is given below to assist in fault finding.

| *Transistor* | *Voltages to Earth* | | |
|---|---|---|---|
| | *Emitter* | *Base* | *Collector* |
| TR1 | −1·0 | −1·1 | −3·4 |
| TR2 | −0·9 | −1·0 | −3·4 |
| TR3 | −2·0 | −2·2 | −6·4 |
| TR4 | −2·0 | −2·2 | −4·5 |
| TR5 | 0 | 0 | −12 |
| TR6 | −0·3 | −0·2 | −6·4 |
| TR7 | −0·6 | −0·8 | −3·0 |
| TR8 | −3·0 | −3·0 | −6·4 |
| TR9 | −3·0 | −3·0 | 0 |

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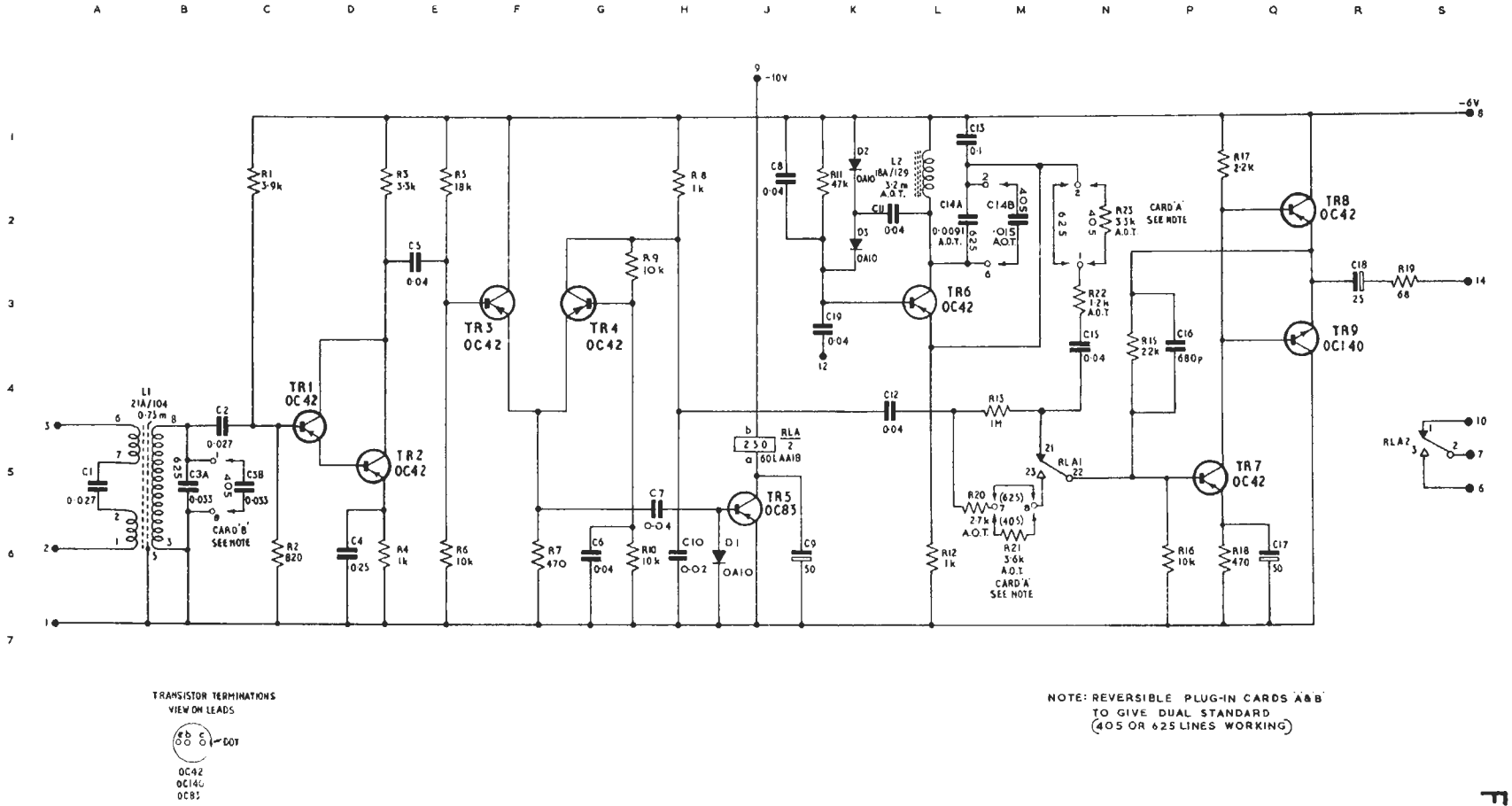
## COMPONENT TABLE: FIG. 10

| Comp. | Loc. | Type | Tolerance per cent | Comp. | Loc. | Type | Tolerance per cent |
|---|---|---|---|---|---|---|---|
| C1 | A5 | G.E.C. P.F. 125V | | R2 | C6 | Erie 109 | 2 |
| C2 | B4 | G.E.C. P.F. 125V | | R3 | D1 | Erie 109 | 2 |
| C3A | B5 | G.E.C. P.F. 125V | | R4 | D6 | Erie 109 | 2 |
| C3B | C5 | G.E.C. P.F. 125V | | R5 | E1 | Erie 109 | 2 |
| C4 | D6 | Dubilier 418 A76 150V | | R6 | E6 | Erie 109 | 2 |
| C5 | E2 | Hunt BM16KV 250V | | R7 | F6 | Erie 109 | 2 |
| C6 | G6 | Hunt BM16KV 250V | | R8 | H1 | Erie 109 | 2 |
| C7 | H5 | Hunt BM16KV 250V | | R9 | G2 | Erie 109 | 2 |
| C8 | J1 | Hunt BM16KV 250V | | R10 | G6 | Erie 109 | 2 |
| C9 | J6 | U.C.C. SC517/8LS 25V | | R11 | K1 | Erie 109 | 2 |
| C10 | H6 | Hunt BM14KV 250V | | R12 | L6 | Erie 109 | 2 |
| C11 | K2 | Hunt BM16KV 250V | | R13 | M4 | Erie 9 | 10 |
| C12 | K4 | Hunt BM 16KV 250V | | R15 | N3 | Erie 109 | 2 |
| C13 | L1 | Dubilier 418 A76 150V | | R16 | P6 | Erie 109 | 2 |
| C14A | L2 | G.E.C. P.F. 125V | | R17 | P1 | Erie 109 | 2 |
| C14B | M2 | G.E.C. P.F. 125V | | R18 | P6 | Erie 109 | 2 |
| C15 | M3 | Hunt BM 16KV 250V | | R19 | R3 | Erie 109 | 2 |
| C16 | P3 | Dubilier 635 350V | | R20 | L5 | Erie 109 | 2 |
| C17 | Q6 | U.C.C. SC517/8LS 25V | | R21 | M6 | Erie 109 | 2 |
| C18 | R3 | U.C.C. SC502/8LS 25V | | R22 | N3 | Erie 109 | 2 |
| C19 | K3 | Hunt BM 16KV 250V | | R23 | N2 | Erie 109 | 2 |
| R1 | C1 | Erie 109 | 2 | | | | |




TRANSISTOR TERMINATIONS
VIEW ON LEADS




OC42
OC140
OC83

NOTE: REVERSIBLE PLUG-IN CARDS 'A & B' TO GIVE DUAL STANDARD (405 OR 625 LINES WORKING)

FIG 10
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# SLAVE LOCK RECEIVING AMPLIFIER AMI/517: CIRCUIT