LINE SENDING AMPLIFIER AM7/505

General Description

The AM7/505 is a 25-dB solid-state video amplifier which gives a maximum output level of +14 dB, with respect to a 1-volt signal, provided that the output is monitored at −29 dB with respect to the output signal. For outside broadcast use, where a monitoring signal at 0 dB with respect to a 1-volt signal is required, the maximum available sending level is reduced to +11 dB.

The amplifier is mounted on a CH1/26B plug-in chassis and has an integral power supply. Mains and signal connections are made at the rear of the unit. Input and output monitoring sockets are provided on the front panel of the amplifier and an additional, low level, monitoring point is provided at the rear of the unit to allow the amplifier output to be monitored remotely.

General Specification

Voltage gain	25 dB ±0·2 dB
Output level	+14 dB max. relative to 1-volt p-p when the monitoring output is at −15 dB relative to 1-volt p-p +11 dB max. relative to 1-volt p-p when the monitoring output is at 0 dB relative to 1-volt p-p
Input and output impedances	75 ohms
Overload point (sine wave)	12·5 V p-p 10 kHz to 200 kHz 12 V p-p up to 5·5 MHz
Pulse-and-bar response (625 line)	No visible distortion
Frequency response	±0·1 dB from 50 Hz to 6 MHz −15 dB at 40 MHz
Luminance-chrominance delay inequality	Less than 3 ns
50-Hz square-wave tilt	Less than 0·5%
Low-frequency overshoot	Zero for a d.c. step signal at the input
Return loss figure (with respect to 75 ohms)	Greater than 30 dB from 10 kHz to 5·5 MHz
Permitted excursion of signal and d.c. at input	Not more than ±3 volts
Thermal stability (10—45 degrees C)	±0·15 V at output
Hum at output	Less than 0·5 mV p-p
Noise figure	Less than 12 dB
Picture signal distortion factor	Less than 0·3% at full output
Differential gain distortion at 4·43 MHz	Less than 0·3% at full output
Differential phase distortion at 4·43 MHz	Less than 0·1° at full output
Maximum ambient temperature	45° C
Mains supply	210—250 V at 50 Hz
Current consumption	74 mA
Weight	3 lb. 10 oz.

Circuit Description

Amplifier

A circuit diagram is shown in Fig. 1.

The input signal is applied via a 28-MHz low-pass filter, which improves the stability of the amplifier and also reduces the risk of high-frequency interference, to the base of TR4. This transistor is a high-gain common-emitter stage and applies an amplified and phase-inverted signal to the base of emitter-follower TR5. This transistor provides a low-impedance output to match the signal to the inter-stage coupling network R20, R21, R22, C12 and C13; it also prevents the low input impedances of the coupling network and TR6 from shunting the collector load of TR4. The inter-stage coupling network provides a phase-lead at frequencies above the video band in order to maintain the stability of the feedback loop. It thus counteracts, to some extent, high-frequency phase-lag in the amplifier. Transistors TR5 and TR6 form a complementary cascode amplifier. Zener diodes D9 and D10 stabilise the d.c. potential in the emitter circuit of TR6 and zener diode D11 provides a low-impedance source of bias for the base of TR7. Local negative feedback is provided by R25 and C17; this feedback substantially reduces phase-shift through the cascode stage.

The signal appearing at the collector of TR7 is direct-coupled to the base of TR8. A signal in phase with the signal applied to the base appears at TR8 emitter and a smaller signal, of inverted polarity, appears at the collector. The latter signal is applied, via R52 and the zener diode bias chain D18 and D13, to the base of TR9. Thus the signal appearing at the collector of TR9 is in the same phase as that appearing at the emitter of TR8 and the output of the amplifier is taken equally from TR8 emitter and TR9 collector.

The main negative feedback loop is from the emitter of TR8 to the emitter of TR4, via R29, C15 and C16. There is an additional feedback path from the collector of TR8 to the base of TR4 via R13, R12 and R11; this path controls only the d.c. and low-frequency response of the amplifier. Low-frequency gain is set by adjustment of R18 and high-frequency gain by adjustment of C16; R15 is adjusted to give zero d.c. at the amplifier output.

Ferrite beads are placed on the cable connecting the amplifier input to C7. Beads are also placed on the connecting lead between transistors TR8 and TR9. These beads suppress parasitic oscillation.

Power Supply

Power supplies at +30 V and −30 V are obtained from a conventional stabilised power supplier. The negative output is held at a fixed potential with respect to earth by zener diodes D7 and D8.

To provide further regulation the outputs from the stabiliser feed into two identical stabiliser circuits which are mounted on the amplifier board. Resistors R41 and R45 are adjusted on test to bring the negative and positive potentials at the emitters of TR13 and TR10 to −25 volts.

Installation and Use

A low-level output signal, for remote monitoring, is available on pin 4 of PLA. This signal is normally at −15 dB with respect to a 1-volt signal (i.e. 29 dB less than the main output) but, for outside broadcast use, a 0-dB monitoring level is required and the maximum sending level is then reduced to +11 dB if the full overload margin is to be preserved. However, in applications where the signal is clamped or d.c.-restored immediately before the amplifier, the output level may safely be raised to +14 dB. With only one or two time constants between the clamp and the amplifier a level of +12 dB may be sent to line with a reasonable overload margin.

To adjust the monitor signal to the correct level for a particular application two extra resistors, R50 and R51, are located on the back of the connector into which the amplifier plugs. These extra components are shown in Fig. 2 and the component values for different main and monitor output levels are shown in Table 1.

TABLE 1

Amplifier Input (dB)	*Amplifier Output (dB)*	*Monitor Output (dB)*	*R50 (ohms)*	*R51 (ohms)*
−11	+14	−15	1·8k	75
−13	+12	−15	1·3k	82
−15	+10	−15	1k	82
−17	+8	−15	750	82
−14	+11	0	0	100

Maintenance

A suspect amplifier can be checked by removing the input signal, terminating input and output in 75 ohms, and checking the d.c. potentials throughout with an oscilloscope or a Model 8 Avometer. The readings obtained should be compared with the typical values given in Table 2; any significant departure from these values should provide an indication of the faulty stage.

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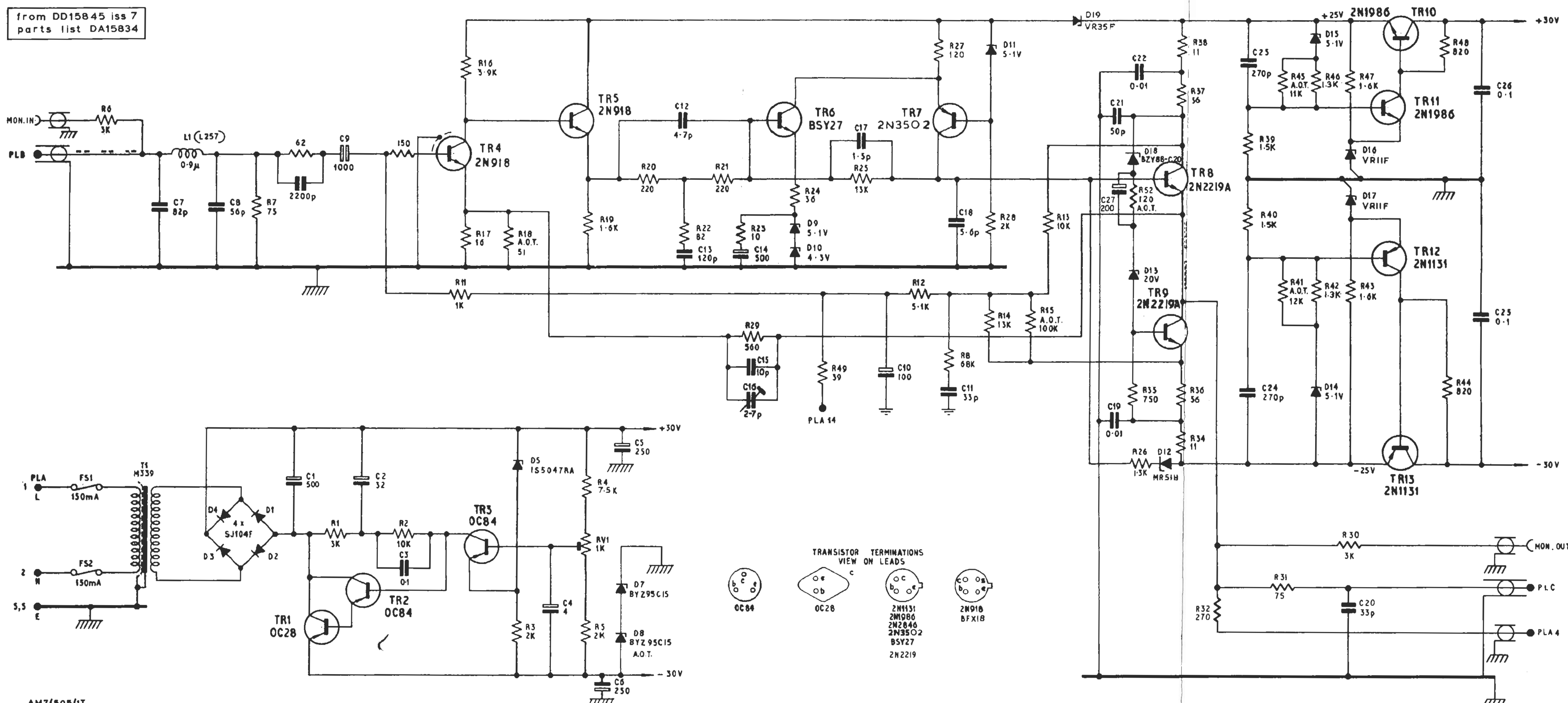

Fig.1 Circuit of the Line Sending Amplifier AM7/505

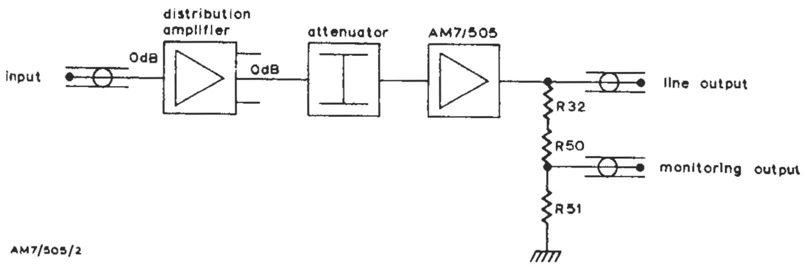

Fig. 2 Components for Adjusting Monitor Output Level (see Table 1)

TABLE 2

Point of measurement	*Volts*
TR4 emitter	+0·04
TR4 base	+0·69
TR4 collector	+12·5
TR5 emitter	+12
TR6 emitter	+10·6
TR6 base	+11·4
TR6 collector	+16·1
TR7 base	+15·9
TR7 collector	+0·60
TR8 emitter	+0·05
TR8 collector	+19·0
TR9 emitter	−19·6
TR9 base	−19·1

If a fault is difficult to locate it may help to open the main feedback loop. This may be done either by disconnecting R29, C15 and C16 or by carefully removing a small portion of the copper foil at this point with a sharp knife or a razor blade. (If the second method is chosen the gap in the foil must be carefully bridged with a short piece of wire when the maintenance is completed.) Typical potentials obtained with the feedback loop broken are given in Table 3. The d.c. potentials were measured with an oscilloscope probe, the input signal having been removed. The signal potentials were measured using an 11·5 pF probe and with a 1T pulse-and-bar waveform, at a level of −40 dB with respect to a 1-volt signal, connected to the amplifier input.

If it becomes necessary to replace a transistor, or any other component mounted on the printed wiring boards, the precautions described in Instruction G.1 should be observed. After the faulty component has been changed it is advisable to check the alignment.

Test Procedure

Apparatus Required

- Wayne Kerr video oscillator type 022D (or similar)
- Tektronix oscilloscope type 515A (or similar) with a suitable probe
- H.F. double-pole changeover box
- General purpose panel connector block type PN3A/2 (modified to DC15806, detail 7)
- 11-dB 75-ohm attenuator
- 14-dB 75-ohm attenuator
- 75-ohm unbalanced wide-band decibel meter type 25A
- Phillips low-frequency amplifier type GM4574 (or a high-gain oscilloscope)
- Polyscop type SWOB, or a signal generator and receiver
- Avometer Model 8
- Pulse and Bar Generator type GE4/504C (625 lines)

TABLE 3

Point of measurement	volts	Signal volts (p-p)	Signal pulse to bar ratio (%)
TR4 base	+0·70	not measurable	not measurable
TR4 emitter	+0·02	not measurable	not measurable
TR4 collector	+13·5	0·56	85
TR5 emitter	+12·5	0·55	120
TR6 base	+12·5	0·2	110
TR6 emitter	+11·5	0·2	110
TR6 collector	+17·0	0·12	not measurable
TR7 base	+16·25	0·12	not measurable
TR7 collector	*	7·5	90
TR8 collector	+19·5	1·7	80
TR8 emitter	*	7·25	95
TR9 base	−19·5	1·5	85
TR9 emitter	−20·0	1·5	90

*With the feedback loop broken the d.c. potentials obtained at these points are so temperature dependent that they cannot be relied on.

Alignment

1. Plug the amplifier into the connector block.
2. Arrange the apparatus so that the video oscillator is switched by the change-over box either direct to the decibel meter or via an 11-dB pad, the amplifier and a 14-dB pad to the decibel meter. Terminate the decibel meter in 75 ohms.
3. Switch on.
4. Wait five minutes for the amplifier to warm up and then adjust RV1 to give 30 volts on the positive rail of the power supply. The negative rail should then also read 30 volts (approximately).
5. Adjust R45 and R41 to give +25 volts and −25 volts respectively on the amplifier positive and negative rails.
6. Set the oscillator to give a 1-volt 10-kHz sine wave. Use the changeover facility to measure the output level of the amplifier on the decibel meter and set the gain of the amplifier to 25 dB ±0·1 dB by adjusting the value of R18.
7. Remove the input signal and terminate the amplifier input. Using the Avometer adjust R52 to give 40·5 volts (±0·5 volts) between the collector of TR8 and the base of TR9.
8. Substitute the oscilloscope for the decibel meter. Terminate the oscilloscope input in 75 ohms and adjust R15 to give zero d.c. at the amplifier output.
9. Replace the decibel meter. Remove the termination at the amplifier input and replace the input signal. Change the video oscillator frequency to 4·43 MHz and adjust C16 to give the amplifier the same gain as at 10 kHz.
10. Replace the oscilloscope. Reduce the oscillator frequency to 10 kHz and adjust the input voltage until limiting just occurs at the top and bottom of the waveform. Check that the output level is 12·7 volts p-p; check also that there are no spurious oscillations (particularly at 500 kHz) at the lower limit of the sine wave just prior to limiting.
11. Use a Polyskop, or a signal generator and receiver, to check the frequency response up to 50 MHz. There should be a peak of not more than +4 dB (typical value 2·5 dB) at 20—28 MHz. The gain of the amplifier should begin to fall at 25—35 MHz and should then continue to fall steadily.
12. Remove the input signal. Terminate the input and output of the amplifier in 75 ohms and then feed the amplifier output to the unterminated oscilloscope via the Phillips amplifier. (If a high-gain oscilloscope is available it can be used direct, in place of the Phillips amplifier.) Check that the hum at the output of the AM7/505 is less than 0·5 mV p-p.
13. Feed a 1T pulse-and-bar waveform into the amplifier, using pads as specified in step 2, and observe the output on an oscilloscope. There should be no visible distortion.