DROITWICH MONITORING RECEIVER RC3/8

Introduction

The RC3/8 receives the 200-kHz Droitwich transmission and provides a 1-MHz output to lock the internal oscillator of an associated frequency monitor[1]

The receiver comprises a 200-kHz receiver and harmonic generator, a pre-amplifier to match the receiver input to a whip aerial, and a mains-driven power supply.

The RC3/8 is constructed on a CH1/12A chassis with a rear-panel mounted aerial connector, PO No 1 (Musa) plug. The front panel carries an output monitoring socket *O/P MON*. Index coding-pegs are not required.

General Specification

Signal Input	
Frequency	200 kHz
Sensitivity	<30 μV for 3-V output at 1 MHz
Impedance	matches 4-foot whip aerial with up to 200-pF lead capacitance
Signal Output	
Frequency	1 MHz
Amplitude	>3 V p-p
Impedance	about 50 ohms
Load resistance	must be greater than 1·5 kilohms
Frequency stability	as Droitwich (better than 2 parts in 10^{11}, long term, not allowing for modulation and propagation effects)
Residual modulation	less than 1% for 80% input modulation
Receiver Gain	between 90 and 100 dB from dummy aerial input to 3-V p-p receiver output
Power Input	240 V a.c., 1 W, fused at 150 mA
Temperature Range	0°C to 40°C ambient
Weight	1 kg

Circuit Description

The circuit diagram of the RC3/8 is given in Fig. 1.

Aerial Pre-amplifier

The pre-amplifier is mounted behind the front panel on a separate printed-wiring board within a screened box. T1 is a 1:5 voltage step-up transformer with a secondary tuned to 200 kHz and damped by R1 (to ensure overall stability). Access to the core of T1 is gained by removing the escutcheon. The source follower TR1 provides substantial current gain and buffers the aerial tuned circuit from the following stages.

200-kHz Tuned Receiver and Harmonic Generator

The stages containing TR2, 3, 4, 5 are electrically-similar wide-band amplifiers with 200-kHz parallel-tuned circuits L1 and L2 to give the required selectivity. Overall stability is enhanced by separate supply decoupling for each stage and by the earth-plane construction.

Automatic gain control is performed by TR6, 7 acting on the amplifier TR3. The output from emitter follower TR6 is peak-detected by D7, 8. The positive-voltage output from TR7 is applied progressively to TR3 by the diodes D5, 6. The a.g.c. action is in two stages. For 200-kHz signals greater in amplitude than about 2·5 V p-p at TR6, diode D6 begins to conduct, increasing the current through R20, thus progressively raising the emitter voltage of TR3 and cutting off the stage. For 200-kHz signals exceeding about 3·5 V p-p, at TR6, diode D5 also begins to conduct and progressively decoupled the base of TR3 through C19. This action provides a range of about 60 dB of automatic gain control.

The harmonic generator TR8, 9 accepts the 200-kHz signal at about 3 V p-p and provides an output at 1 MHz of approximately the same amplitude. TR8, 9 form a long-tailed pair; TR9 has a 1-MHz tuned circuit C41, C42, L3 as its collector load. Design of this stage is such that if the input signal applied from TR5 is significantly lower in amplitude than 3 V p-p or if the signal from TR5 is severely distorted (due, for example, to a.g.c. failure) then the 1-MHz output will diminish in amplitude.

The 1-MHz signal is passed to the output by emitter followers TR10, 11. The minimum acceptable load impedance (to avoid clipping) is about 1·5 kilohms.

Power Supplier

A bi-phase rectifier circuit drives two 9-V zener-diode regulators which provide separate supplies at +9 V to the pre-amplifier and receiver respectively.

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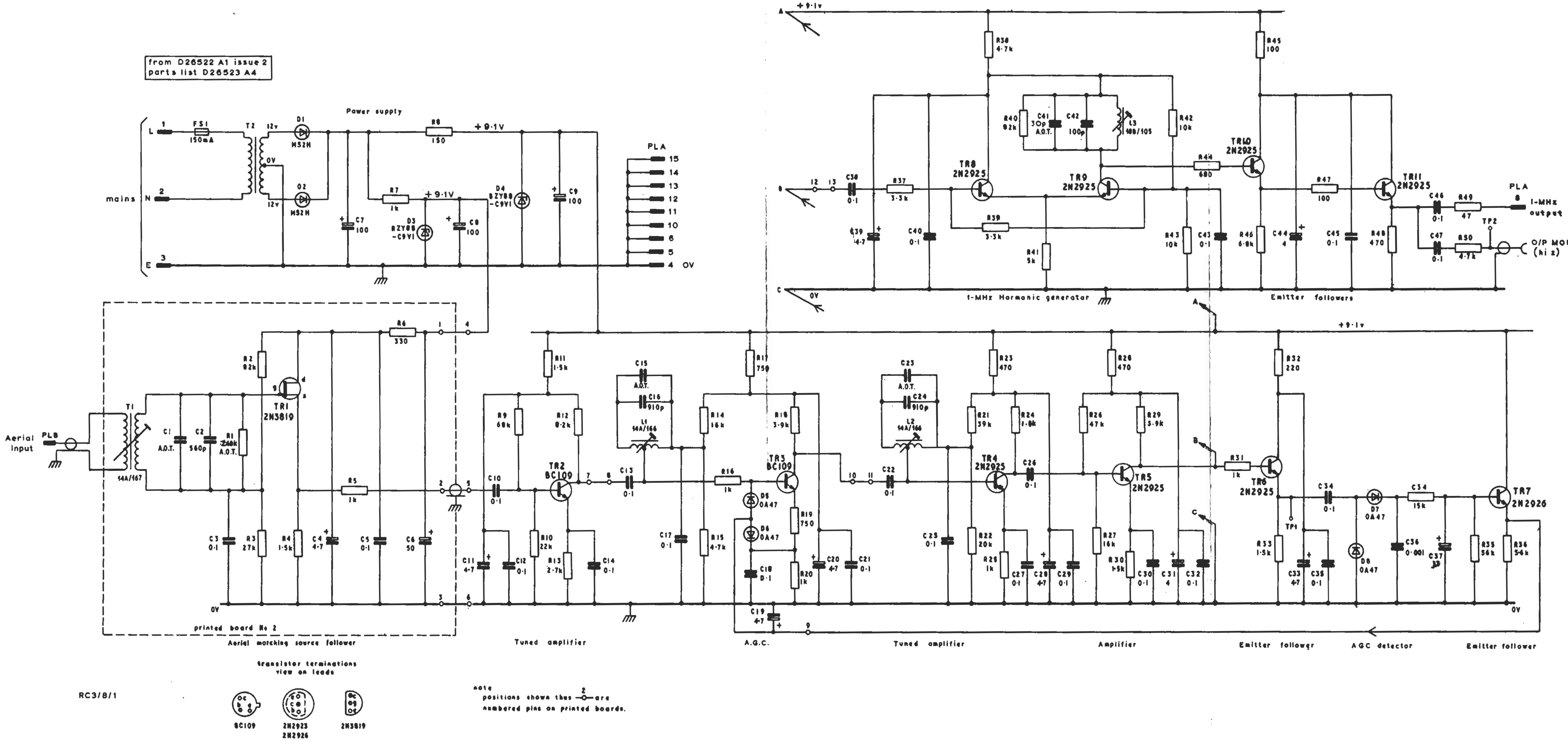

Fig. 1. Circuit Diagram of the RC3/8

Installation

The RC3/8 is aligned on Production Test using the the procedure given below with a dummy aerial (circuit shown in Fig. 2). To maintain this alignment the installed aerial should be a 4-foot whip with a down-lead capacitance not exceeding 200 pF. (The down-lead capacitance attenuates the signal and therefore should be as small as possible.)

The down-lead must be completely screened between aerial and receiver input connector or instability due to cross-talk from the output may result.

Procedure

1. Connect the receiver to the mains via the Painton socket and switch on. Use the Avo 8 to check that the pre-amplifier and receiver power-supply rails are both at +9 ± 0·5 V w.r.t. chassis.
2. Disconnect the link between pins 12 and 13. Use the frequency counter to adjust the oscillator frequency to 200 kHz ± 200 Hz. Terminate the oscillator output in 75 ohms and connect the output via a 3·9-kilohm resistor to pin 13.
   Set the signal amplitude at pin 13 to 3 V p-p.

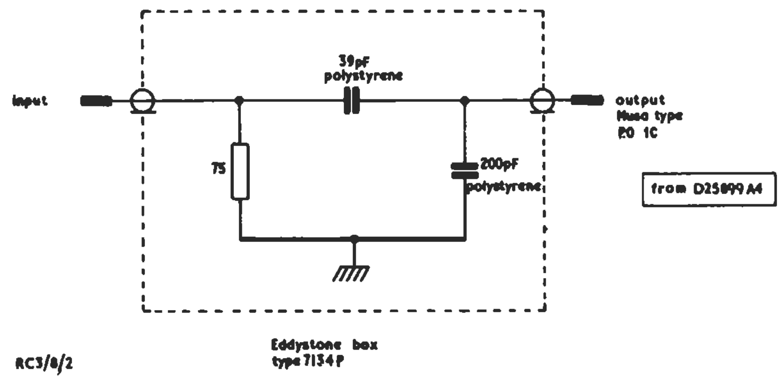

Fig. 2. Circuit of the Dummy Aerial

Alignment

Equipment

Oscillator capable of supplying 200 kHz ± 200 Hz at 1 V p-p into 75 ohms (e.g. Wayne Kerr Type 022D)

Frequency Counter capable of measuring 200 kHz to 1 part in 10^5 (75-ohm input)

75-ohm Attenuator capable of attenuating the oscillator output by 130 dB with a resolution of 0·5 dB

Dummy Aerial as shown in Fig. 2

Oscilloscope (Tektronix 515 or equivalent)

X10 High-impedance Probe

Avo 8

Trimming Tool (Mullard Type 2047)

PN3A/2 connected thus and with holes drilled to give access to the aerial connector:

- 1 Live
- 2 Neutral
- 3 Earth (Mains)
- 8 Receiver Output
- 6 or 10 Receiver Output Earth

Adjustment of Vinkors L1, 2, 3, T1

In the procedure steps 3 to 6, two spaced maxima should be obtained on adjusting each Vinkor throughout its range. If only *one* maximum is obtained, increase the value of the appropriate AOT capacitor. If *no* maximum is obtained, reduce the value of the AOT capacitor. Set the adjuster to the maximum at which the core is further in.

Adjust the core of L3 for maximum 1-MHz output at TP2. Check that the output is in fact at 1 MHz and not another harmonic of 200 kHz.)
For 1-V p-p unterminated receiver output the terminated oscillator output should be less than 0 dB w.r.t. 1 V p-p.
Reconnect the link.

3. Disconnect the link between pins 10 and 11. Use the frequency counter to adjust the oscillator frequency to 200 kHz ± 200 Hz and connect the correctly-terminated output of the oscillator via a 3·9-kilohm resistor to pin 11.
   Attenuate the oscillator output to give 2 V p-p at TP1.
   Adjust the core of L2 for maximum amplitude at TP1. Progressively attenuate the input signal to maintain 2 V p-p output as the maximum is reached.
   The oscillator output should be less than –45 dB w.r.t. 1 V p-p.
   Reconnect the link.
4. Disconnect the link between pins 7 and 8.
   Use the frequency counter to adjust the oscillator frequency to 200 kHz ± 200 Hz and connect the correctly-terminated output of the oscillator via an 8·2-kilohm resistor to pin 8.
   Attenuate the signal amplitude at pin 8 to give about 2 V p-p at TP1. Adjust the core of L1 for maximum amplitude at TP1. Progressively attenuate the input signal as the maximum is reached.

The oscillator output should be less than −46 dB w.r.t. 1 V p-p.
Reconnect the link.

5. To check correct operation of TR1 and TR2 connect the attenuated oscillator output to the aerial input. Attenuate the signal to give 2 V p-p receiver output. The attenuation required should be greater than 100 dB.
6. Connect the 200-kHz signal to the dummy aerial input and connect the output to the receiver input with a Musa lead not longer than 1 foot.
   Attenuate the oscillator output to give 2 V p-p at TP1.
   Adjust the core of T1 for maximum output, attenuating the input if necessary to maintain the 2 V p-p output.
7. Select a value of R1 (across C1 and C2) so that for between 90 and 100 dB attenuation of the signal into the dummy aerial, the signal at TP1 is 2 V p-p very roughly 5% of the time. The value of R1 is typically 240 kilohms. (Keep the screening box of the pre-amplifier earthed while making measurements.)
8. Increase the oscillator output to give noise-free receiver output. Transfer the oscilloscope probe to the front-panel monitoring point; check that the signal is greater than 3V p-p.
9. Replace the pre-amplifier on the front panel and re-fit the escutcheon.

References

1. Precision Subcarrier Frequency Monitor MN7M/504

RDH 8/72