LEVELL

TRANSISTOR R.C. OSCILLATORS

TYPES TG150, TG150D, TG150M & TG150DM

- 1.5 c/s to 150 kc/s
- CONSTANT AMPLITUDE
- LOW DISTORTION
- STABLE FREQUENCY
- NO WARM-UP DRIFT
- NO MAINS HUM
- PORTABLE

TYPE TG150M

These R.C. oscillators use transistors as the active components with the advantage of freedom from many of the defects that exist in comparable valve oscillators. The much lower power consumption of the transistor results in the elimination of slow drifts of frequency and amplitude that are characteristic of valve oscillators during the warm-up period. The low power consumption also permits long life batteries to be used as the power supply with the complete elimination of hum modulation.

The circuit of the oscillator comprises a transistor amplifier with positive feedback applied via a Wien bridge selective network and negative feedback applied via a thermistor amplitude stabilising network.

The resonant frequency of the Wien bridge is continuously variable over one decade by a calibrated frequency control. Five ranges are provided to give a coverage from 1.5 c/s to 150 kc/s with an effective total scale length of 50 inches (i.e. 127cm).

A considerable degree of negative feedback is applied via the amplitude stabilising network to ensure that the output is constant over the entire frequency range and is negligibly affected by variations of the supply voltage and ambient temperature.

The square wave output of the dual waveform versions is produced by double clipping the sine wave output by an overdriven amplifier stage.

SPECIFICATION OF TYPE TG150 SERIES

VARIATIONS

Type TG150 : Sine wave output only. No output meter.
Type TG150D : Sine and square wave outputs. No output meter.
Type TG150M : Sine wave output only. Output meter fitted.
Type TG150DM: Sine and square wave outputs. Output meter fitted.

FREQUENCY

1.5 c/s to 150 kc/s continuous coverage in 5 ranges at decade intervals.

ACCURACY

± (3% + 0.15 c/s).

STABILITY

Less than ±0.05% short term drift after an initial 30 seconds.
Less than 0.3% frequency change at 1 kc/s for 30% fall from full supply voltage.
Change of frequency with temperature is typically less than ±0.05% per °C.

DISTORTION

Harmonic content of sine waves is less than 0.1% at 1 kc/s, less than 0.3% from 50 c/s to 15 kc/s, and less than 1.5% below 50 c/s and above 15 kc/s.

SINE WAVE OUTPUT

Continuously variable up to 2.5V into 600 ohms.
Less than 0.1dB variation of amplitude over the total frequency coverage.
Less than 0.05dB change of output for 30% fall from full supply voltage.
Change of amplitude with temperature is typically —0.02dB per °C.
Output impedance is less than 250 ohms direct and 600 ohms ± 1% via attenuator.

SQUARE WAVE OUTPUT

Continuously variable up to 2.5V peak with an output impedance which rises from zero up to 600 ohms at maximum output and 600 ohms ± 1% via attenuator.
The amplitude of the square waves is directly proportional to supply voltage.
The rise time is approximately 1% of the periodic time plus 0.2 microseconds.

OUTPUT METER SCALES

0 to 2.5V ± 5% and —10dB to +10dB relative to 1 mW into 600 ohms.

ATTENUATOR

20dB ± 0.2dB, 40dB ± 0.3dB, and 60dB ± 0.4dB.

TEMPERATURE

The characteristics specified above are measured at 25°C but only minor divergencies exist from —10°C to +45°C.

POWER SUPPLY

18V D.C. supplied by two Ever Ready type PP9 batteries or equivalents.
Battery life is typically 400 hours under normal use. Provision is made for checking the batteries at the selection of a test position on a switch.

FINISH

Robust steel case stove-enamelled in silver-grey hammer tone.
Calibration and control markings are on a double anodised aluminium panel.

SIZE AND WEIGHT

10" x 6" x 4" (i.e. 25 cm x 15 cm x 10 cm), 6lbs. (i.e. 2.7 kg.) with batteries.

LEATHER CASE TYPE LC2

This leather case is available as an optional extra. It is board-stiffened and lined with green felt. A carrying handle is fitted on the case and a detachable shoulder strap is provided.

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TRANSISTOR R.C. OSCILLATORS TYPES TG150, TG150M, TG150D & TG150DM.

LEVELL TRANSISTOR R.C. OSCILLATORS TYPE TG150 SERIES.

These resistance-capacity oscillators use transistors as the active components with freedom from many of the defects which exist in comparable valve oscillators. The much lower power consumption of the transistor oscillator results in the virtual elimination of the slow drifts of frequency and amplitude that are characteristic of valve oscillators during the warm-up period. The low power consumption also permits long life batteries to be used as the power supply with the complete elimination of hum modulation that often occurs in mains driven oscillators. Low harmonic distortion is also more easily achieved as transistor characteristics are more linear than valve characteristics.

The basic circuit of the type TG150 oscillator comprises a transistor amplifier with positive feedback applied via a Wien bridge selective network and negative feedback applied via a thermistor amplitude stabilising network. Type TG150M differs from type TG150 by the addition of an output meter. Types TG150D and TG150DM have the additional feature of sine or square wave output.

The resonant frequency of the Wien bridge network is continuously variable over one decade by a calibrated frequency control. Five ranges are provided to give coverage from 1.5c/s to 150kc/s with an effective total scale length of about 50 inches (i.e. 127cm.)

A considerable degree of negative feedback is applied via the thermistor amplitude stabilising network with the result that the output is remarkably constant over the entire frequency range and is negligibly affected by variations of the supply voltage and ambient temperature.

Two transistors are used in the sine wave output stage in a linearised emitter follower configuration in order to ensure that the output of the oscillator is negligibly distorted despite the fact that the supply current is low. The square wave output of the dual waveform versions is produced by double limiting the sine wave output by an overdriven amplifier stage.

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OPERATING INSTRUCTIONS FOR TYPE TG150 SERIES.

1. Connection of Power Supply.
   (a) Remove the four screws from the back panel.

   (b) Place Batteries in compartment provided with the connections uppermost and connect the snap fasteners.

   (c) Replace the back panel and ensure that the screws are tight enough to make a good electrical connection between the panel and the case.

2. To Check Supply.
   (a) Turn to "Check Supply" position on the "Attenuator" switch.

   (b) On Types TG150 and TG150D observe the indicator lamp which should light when the batteries are in good condition.

   (c) On Types TG150M and TG150DM read the value of the supply voltage on the meter which has a full scale deflection of 25 volts on this test. Replace the batteries when the indication is less than 14 volts after allowing 15 seconds for the meter to settle at a steady reading.

3. To use the Oscillator.
   (a) Turn the "Attenuator" switch fully clockwise.

   (b) Turn the "Range" switch and frequency control as desired.

   (c) Turn the "Volts" control as desired.

   (d) The output voltage may be attenuated to 1/10th, 1/100th or 1/1000th of the chosen value by the use of the -20, -40 or -60dB positions of the "Attenuator" switch.

4. To use the Voltmeter on Types TG150M and TG150DM.
   (a) Turn the Oscillator to an operating condition at a frequency above 15c/s.

   (b) Turn the "Volts" control fully anti-clockwise.

   (c) Set the mechanical zero adjustment on the meter to give zero reading on the voltage scale.

   (d) The meter will now read the output voltage with greater accuracy than the approximate calibration on the "Volts" control.

5. <u>Adjustment of "Set Output" Control.</u>

This adjustment is normally made at 25° C. but may be made at an alternative temperature to suit the operating conditions of the oscillator.

(a) Connect a precision A.C. Voltmeter across the output terminals to read 2.5 volts.

(b) Turn the "Volts" control to 2.5 Volts on sine waves.

(c) Set the frequency at 50 c/s.

(d) Adjust the "Set Output" control to give an output of 2.5 volts on the meter.

6. <u>Adjustment of Frequency Calibration.</u>

This adjustment should only be undertaken when the frequency calibration is outside the specification limits. The following test equipment is required to make the adjustment:-

(1) An oscilloscope for comparing frequencies by means of Lissajous figures.

(2) A variable reference oscillator covering a frequency range of at least 30c/s to 30kc/s.

(3) A standard oscillator of frequency 100kc/s ± 0.1%.

The adjustment is made as follows:

(a) Adjust the "Set Output" control as previously specified and leave the oscillator on sine wave output.

(b) Ensure that the "Frequency" control is firmly clamped to the case of the instrument.

(c) Fit the Frequency knob on the control shaft at a position which gives free rotation over the whole of the scale.

(d) Turn to 500c/s on the scale and compare the frequency with that of the reference oscillator. Adjust the reference frequency to coincide exactly with that of the oscillator under test.

(e) Turn the frequency knob to the points at approximately 1500c/s, 1000c/s, 250c/s and 167c/s where the frequency is exactly a multiple or submultiple of the reference frequency.

Note the percentage errors at each setting. They should not exceed ± 1% when the Frequency knob has been located on the shaft in the optimun position. Refix the knob and repeat the above procedure until the errors are within ± 1%. Clamp both grub screws in this position.

(f) Set the oscillator to 20kc/s on the scale and compare with the standard frequency of 100 kc/s. Adjust the trimmer TC1 (nearest the Range switch) for a 5:1 Lissajous figure.

(g) Check the calibration errors at 100kc/s and 150kc/s and adjust TC2 so that the errors at these frequencies are of equal magnitude and opposite sign and, in any case, less than ± 2% of the indicated frequency.

(h) Set the oscillator to 20kc/s exactly by comparison with the 100kc/s standard then replace this standard with the reference oscillator and adjust the reference to exactly 5kc/s by comparison with the known 20kc/s signal. Now set the oscillator under test to the 15kc/s range and check the calibration errors at 2.5kc/s, 5kc/s and 10kc/s. If the calibration indicates more than 3% low, add the link which connects C6 in parallel with C7 (h to h'). This will decrease the frequency by 5%. If the calibration reads more than 3% high, connect C7 in series with C8. This will increase the frequency by 5%. Check that the calibration over the range does not exceed ± 3%. In a few instances when all tolerances are at the limits it will be found that the error cannot be reduced below 3.5% at one point on the scale by the above method. The procedure then adopted is to add a link from d to d' on the switch and then repeat the above.

(i) Set the reference oscillator to 500c/s by dividing down in steps relative to the 100 kc/s standard and set the oscillator under test to the 1.5kc/s range. Check the calibration errors at 250c/s, 500c/s and 1kc/s. If the calibration indicates low add the link (g to g') which connect C7 in parallel with C8. This will decrease the frequency by 5%. If the calibration indicates high, connect C8 in series with C9., this will increase the frequency by 5%. Check the calibration error over the range does not exceed $\pm$ 3%. If necessary, connect a link between d and c' and repeat the above.

(j) Set the reference oscillator to 50 c/s relative to the standard and check the calibration of the oscillator at 25c/s, 50c/s and 100c/s. If the calibration indicates low, add the link which connects C9 in parallel with C8 (f to f'). If the calibration indicates high, connect C9 in series with C10. Check the calibration error over this range does not exceed $\pm$ (3% + 0.15c/s). If necessary, add a link from c to b' and repeat the above.

(k) Leave the reference oscillator set at 50c/s and set the oscillator under test to 10c/s. If the calibration indicates low, add the link which connects C9 in parallel with C10 (e to e'). If the calibration indicates high add a 1 kilohm resistor in series with C1. The error should not exceed $\pm$ (3% + 0.15c/s).

GUARANTEE

We undertake to repair, or replace free of charge, any components that fail in this instrument within 12 months from date of purchase, provided that,

(a) the guarantee card is posted within 14 days of purchase and

(b) the instrument is not, in our opinion, modified or misused.

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SPECIFICATIONS OF R.C. OSCILLATORS TYPE TG150 SERIES.

VARIATIONS

TYPE TG150 : Sine wave output only. No output meter.

TYPE TG150D : Sine and square wave outputs. No output meter.

TYPE TG150M : Sine wave output only. Output meter with volts and dB scales.

TYPE TG150DM : Sine and square wave outputs. Ouput meter with volts and dB scales.

FREQUENCY

1.5c/s to 150kc/s in 5 ranges at decade intervals.

ACCURACY

$\pm$ (3% + 0.15c/s).

STABILITY

Less than $\pm$0.05% short term drift after an initial 30 seconds. Frequency change is less than 0.3% at 1kc/s, for a 30% reduction of the supply voltage. Frequency rate of change with ambient temperature is typically less than $\pm$0.05% per deg.C.

DISTORTION

Harmonic content of sine wave is less than 0.1% at 1kc/s less than 0.3% from 50c/s to 15kc/s and less than 1.5% below 50c/s and above 15kc/s.

OUTPUT ON SINE WAVES

Continuously variable up to 2.5V into 600 ohms. The variation of the output with frequency is less than 1% over the total frequency coverage. The change of amplitude for a 30% fall of the supply voltage is typically less than 0.5%. The rate of change of amplitude with ambient temperature is typically -0.2% per deg.C. The source impedance is 600 ohms $\pm$ 1% via the attenuator and less than 250 ohms direct.

OUTPUT ON SQUARE WAVES.

Continuously variable up to 2.5V peak source voltage at an impedance which rises from zero to 600 ohms at maximum output. The amplitude is directly proportional to the supply voltage.
The rise time is approximately 1% of the periodic time plus 0.2µS.

OUTPUT METER.

Black scale 0 to 2.5V. $\pm$ 5%. Red scale -10dB to + 10dB relative to 1mW in 600 ohms.

ATTENUATOR

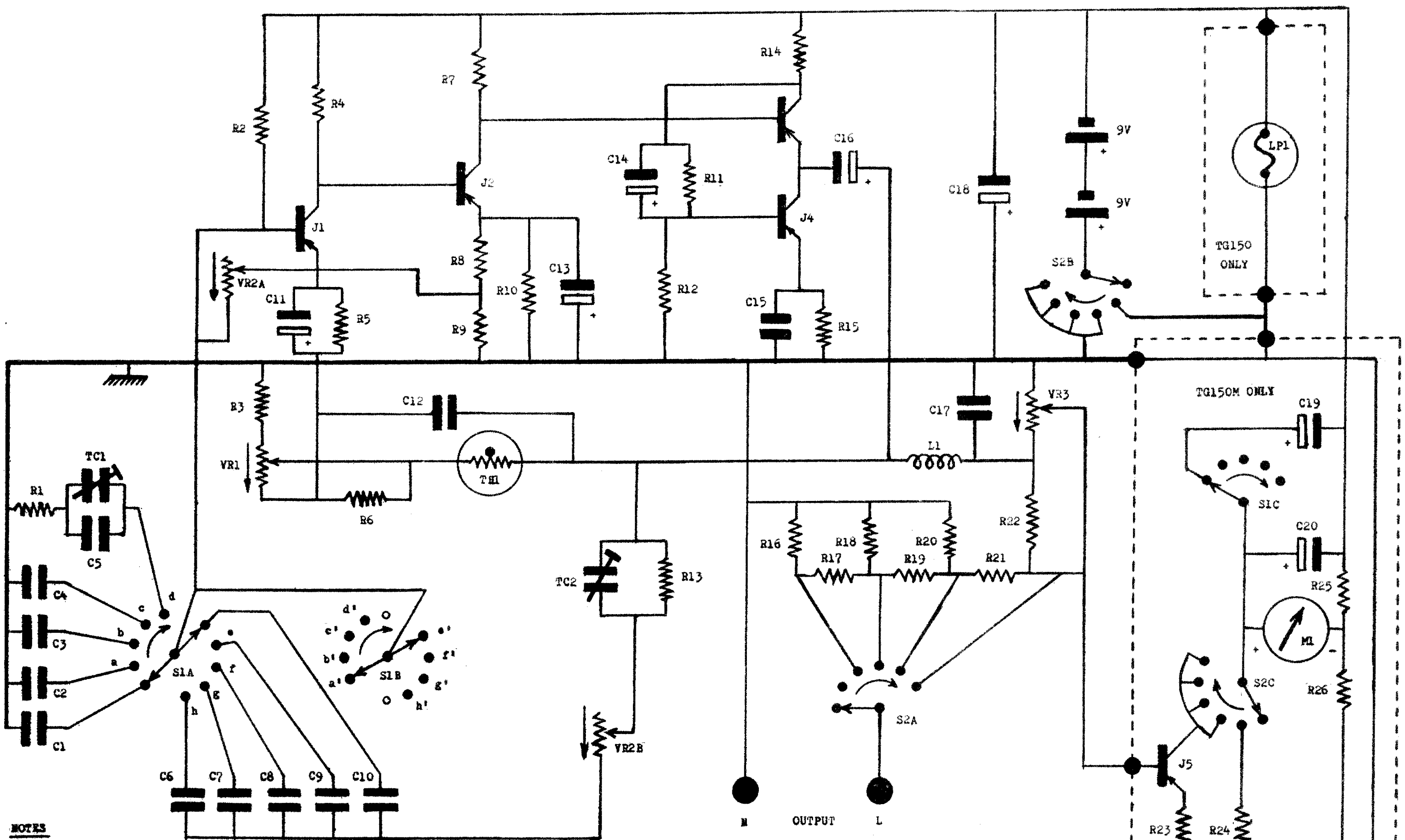
20dB $\pm$ 0.2dB, 40dB $\pm$ 0.3dB, and 60dB $\pm$ 0.4dB.

TEMPERATURE

The characteristics specified above are measured at 25°C but only minor divergencies exist from -10°C to +45°C.

SUPPLY

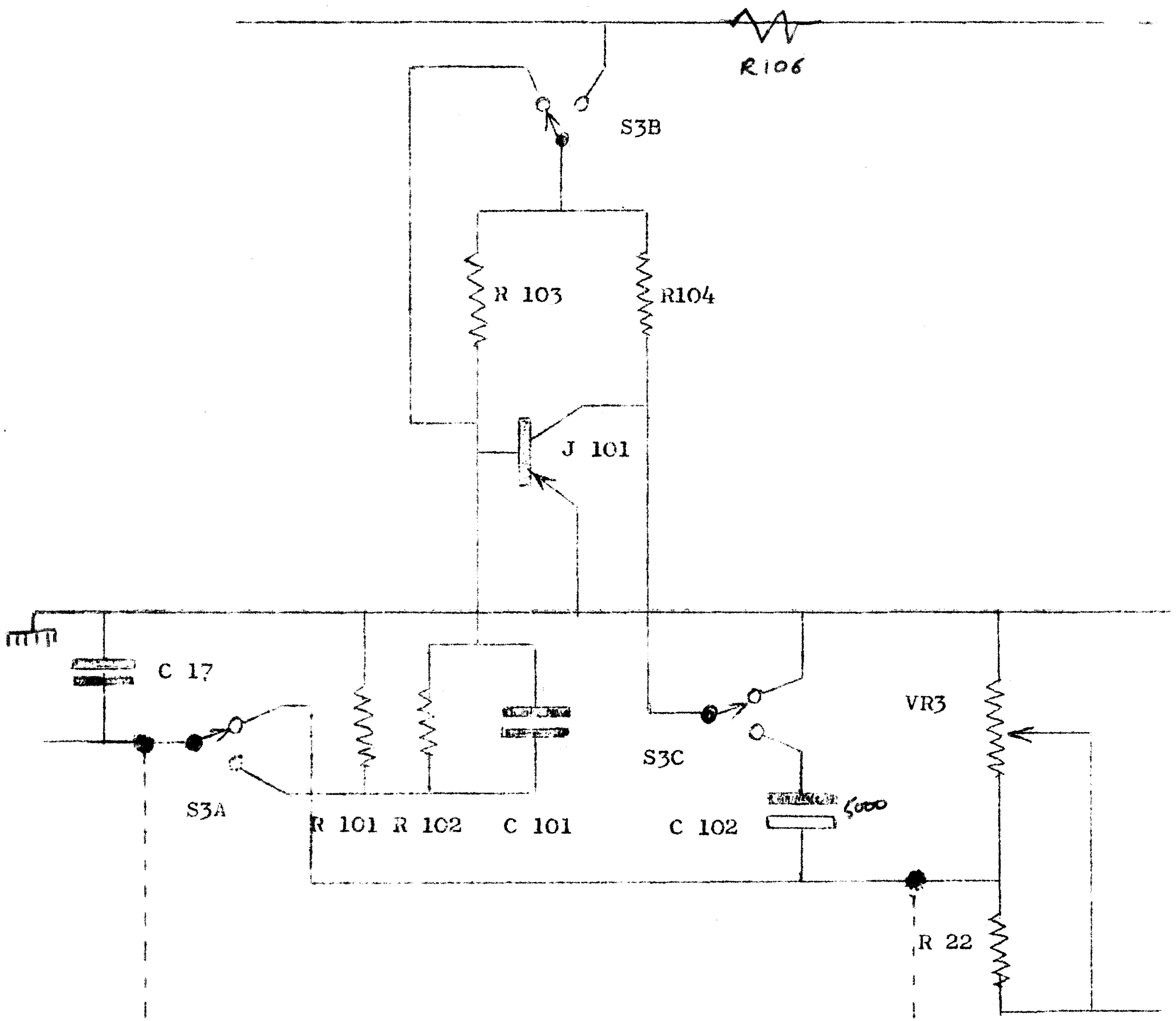
18V D.C. provided by two Ever Ready type PP9 batteries. Battery life is typically 400 hours under normal use.



NOTES

(1) Links may connect a to a', b to b' etc.
(2) C2 may connect to live end of C1 instead of to E.
(3) C3 may connect to live end of C2 instead of to E.
(4) C4 may connect to live end of C3 instead of to E.

LEVELL TRANSISTOR R.C. OSCILLATORS TYPES TG150 & TG150M



SQUAREING STAGE CIRCUIT INCLUDED IN LEVELL TYPE TG150D & TG150DM R.C. OSCILLATORS.

Levell Oscillator TG150, TG150D, TG150M & TG150DM Components List

R1 1500
R2 12M
R3 390
R4 100k
R5 10k
R6 2200
R7 10k
R8 10k
R9 10k
R10 2700
R11 15k
R12 1500
R13 5k
R14 180
R15 120
R16 660
R17 5940
R18 733
R19 1000
R20 733
R21 5940
R22 6800
R23 1040
R24 13.5k
R25 6800
R26 15k
R27 2200

R101 1200
R102 1200
R103 33k
R104 3300
R105 120

VR1 1000
VR2 50k + 50k
VR3 1000

C1 2uF
C2 0.2uF
C3 0.02uF
C4 0.002uF
C5 100pF
C6 200pF
C7 0.002uF
C8 0.02uF
C9 0.2uF
C10 2uF
C11 100uF
C12 22pF
C13 100uF
C14 100uF
C15 1000uF
C16 1000uF
C17 470pF
C18 1000uF
C19 1000uF
C20 50uF

C101 1500pF
C102 5000uF
TC1 + TC2 30 – 80pF

J1 – J5 Texas 2G302 or Mullard OC44

J101 Texas 2G302 or Mullard OC44

L1 30uH

LP1 19v 90mA
TH1 STC R54

R27 is in series with the base of J5
R105 only in TG150DM – sw in series with R23 by S3D on square.