

PCB 75021

11.1 Introduction

This circuit comprises the regulators for the MJS401D stabilised ± 18 V and +5 V supplies, the power amplifier stage for the internal loudspeaker, and the unstabilised +48 V and +8 V supplies for the MD404B oscillator.

11.2. Circuit Description

11.2.1 Power Supply Unit

The three mains transformer secondary windings are connected by PL3 and PL4 to three bridge rectifier circuits.

11.2.2 ± 18 V supplies

The secondary winding output for the ± 18 V power supply is full-wave rectified by the diode bridge, D1 to D4, the positive output being smoothed by reservoir capacitor C1 and the negative output by C2. A 47 nF disc ceramic capacitor is connected across each diode. These capacitors are important; they maintain the common-mode impedance to ground of the power supply rails constant, regardless of whether the diodes are turned on or off at the time.

The positive output is fed to IC1, a 723 voltage regulator. Zener diode D5, decoupled by C3 maintains the base of TR2 at about +12 V and supplies the V+ input for IC1 and IC2. TR2, in common base mode, passes the output current of IC1 to control the series Darlington transistor TR6. TR2 withstands higher voltages than IC1 is otherwise capable of.

A portion of the output voltage developed across VR2, R18, R19, is fed to the inverting input IC1/4 for comparison with the internal reference (Vref on IC1/6).

Frequency compensation is given by R10 and C7 connected to pin 13.

Any tendency for the output voltage to change with respect to the reference voltage is sensed in IC1 and provides a corrective output at IC1/11. If the voltage across R19 drops, for example, the output on IC1/11 is reduced accordingly. In turn, the potential on TR2 collector is lowered to increase the conductivity of the series power transistor TR6 to restore the output voltage.

TR1 serves to protect the series transistor TR6 against excessive load currents. Heavy currents through R17 produce an increased base-emitter voltage on TR1, which turns on in order to limit the drive to TR6.

The regulated output on the collector of TR6 is decoupled by C10 and can be preset to +18 V by VR2.

The -18 V supply circuit is derived from a J-FET input op-amp IC2 (LF351). The midpoint of the +18 V and -18 V outputs via VR1 provide the sensing input IC2/3 for comparison with the 0 V line on inverting input IC2/2.

TR4, in common base mode, passes the output current of IC2 to series Darlington transistor TR5. TR4 withstands higher voltages than IC2 is otherwise capable of.

Zener diode D6, decoupled by C6, provides a semi-regulated -12 V supply for IC2 from the -18 V unregulated line.

TR3, R16, R12 and R11 provide foldback current limiting for the -18 V rail. The regulated -18 V output on the collectors of TR6 is decoupled by C9. C8 and R15 serve to ensure stability in the control loop.

11.2.3 +48 V supply

The voltage on the secondary winding to PL4 is full-wave rectified by the diode bridge D12 to D14 and smoothed by the two electrolytic capacitors C18, C19. Disc ceramic capacitors are fitted across the diodes, similarly to those across D1 to D4.

This provides a +48 V supply on PL5 for the oscillator unit.

11.2.4 +8 V, +5 V supplies

The voltage across the single secondary winding to PL3/1,2 is full-wave rectified by diode bridge D7 to D10 and smoothed by C16 to provide a +8 V output on PL2/1. Once again, capacitors are fitted across the diodes.

The bridge output also supplies a voltage regulator, IC4, which provides a +5 V output on PL2/3, decoupled by C17.

11.2.5 Speaker Amplifier

The speaker amplifier comprises a low-noise, J-FET input op amp, IC3, followed by a complementary-pair output stage TR7, TR8.

The output from the signal rectifier card is applied via the slider of the front-panel MONITOR potentiometer on PL1/1, and coupled via C13 to the non-inverting input of IC3. The stage gain (10 approx.) is determined by R21 and R20, with HF roll-off applied by C12.

The 18 V positive and negative supplies for IC3 are derived from the stabilised 18 V rails and decoupled by C14 and C15 respectively.

The complementary output transistors TR7 and TR8 are fed from the unregulated 18 V supply rails since their collector voltage is not critical. The monitor output on their common emitters is fed via R24 and PL1/4 to the internal speaker and the front-panel PHONES socket for aural monitoring.

11.3 Removal/Replacement

11.3.1 Removal

The Power Supply/Speaker Amplifier assembly should be removed from the back panel as a whole, complete with its integral heat sink.

Switch off the mains and remove the mains lead.

Remove the four screws which retain the back panel to the mainframe. Fold down the back panel and unplug all the connectors to the board.

Remove the two screws which go through the back panel and the heat sink, along with their nuts and shakeproof washers. Remove the six screws which go into tapped bushes in the PCB.

11.3.2 Replacement

If any of the power devices (TR5, TR6, IC4) are removed from the heatsink, they must be replaced with clean mica washers and thermal paste. On no account allow any swarf to come between the washer and the device or heat sink. Use (preferably) a 250 V insulation tester, or (at least) an ohm-meter, to confirm isolation between the device tabs and the heat sink.

Cleanliness and thermal paste must also be used between the heat sink and the back panel!

Use low strength thread locking compound (e.g. Bostik T22) on all eight screws which retain the assembly to the back panel. Do not tighten any of the screws until all eight are in place; this will allow tolerances to be taken up.

Otherwise, replacement is the reverse of removal.

11.4 Fault Finding

The Power Supply/Speaker Amplifier should be tested as a separate assembly, complete with its integral heat sink. For load tests, the assembly should be mounted on the MJS401D back panel as normal, or another heat sink added, as there is no thermal protection on this board.

Since the -18 V rail tracks the +18 V rail, it cannot be correct unless the +18 V rail is correct. Therefore, if both the ± 18 V rails are faulty, correct the +18 V first.

11.4.1 No-Load Tests

Bring mains up slowly via variac. Switch off immediately if there is any sign of devices getting hot. The d.c. conditions on the card should be as follows:-

	<u>min (V)</u>	<u>nom (V)</u>	<u>max (V)</u>
Across C1:	23	24	25
Across C2:	23	24	25
Across C16:	8.5	9.5	10.5
IC4 output (or PL2 pin 3)	4.75	5	5.25
Across C18 or C19	50	52	54
Across D5:	11.4	12	12.6
Across D6:	11.4	12	12.6
IC1 pins 6 & 5 to C1 negative:	+6.5	+6.8	+7.3
IC2 pin 6 to C1 negative:	+0.5	+0.55	+0.65
TR7 case to C1 negative:	+23	+24	+25
TR8 case to C1 negative:	-23	-24	-25
PL1 pin 4 to PL1 pin 7:	-15 mV	0	+15 mV

11.4.2 Adjustment of ± 18 V rails

Connect DVM between +18 V and ground (PL1 pins 6 and 3)

Adjust VR2 for +18.00 Volts

Connect DVM between -18 V and ground (PL1 pins 5 and 3)

Adjust VR1 for -18.00 Volts

11.4.3 Load tests

Connect DVM and 'scope between the +18 Volt and ground as close to the supply voltage "Sensing" points as possible, i.e. across C10. Set 'scope timebase to 1 ms/div and vertical amplifier to 1 mV/div.

Switch in a load of 22 Ω 20 W and measure the drop in +18 V supply voltage on the DVM. This should be less than 20 mV.

Observe the scope trace and look for any 100 Hz spikes, noise, or instability both on and off load. The 'scope trace should display no more than 5 mV ripple, with no trace of instability and very little noise, on or off load.

Repeat the above procedure for -18 V rail. Connect DVM and 'scope across C9 (NB Ground on positive side).

Connect scope DVM to 5 V supply rail. The drop in output voltage should be no more than 50 mV when a load of 4.7 Ω 6 W is switched on. The scope should

display no more than 50 mV ripple on load, with no trace of noise or instability on or off load.

11.4.4 Short-circuit current measurement

Measured by using a parallel combination of DVM and 1 ohm 2 watt resistor. Connect it in turn to the +18, -18, and 5 V supplies to measure short-circuit current. Do not apply this load for more than a few seconds! The short circuit currents should be as follows:-

+18 V approx 0.85 A

-18 V approx 0.85 A

5 V approx 1.2 A

11.4.5 Speaker Amplifier

Connect a 68 Ω , 1 W resistor between pins 4 and 7 on PL1 (L.S. Output). Apply approximately 0 dBu to speaker amp input (PL1 pins 1 and 2) at 1 kHz. Observe output of speaker amp with scope. The speaker amplifier should produce approximately 16 V peak-to-peak before clipping.

Change input signal frequency to 100 Hz and to 10 kHz and check for no significant level change. Check crossover distortion not excessive. Note that this design of amplifier does produce noticeable crossover distortion. It is only intended to listen to programme for identification purposes, and is not intended as a quality reference.

11.5 Calibration

It is assumed that the power supply is functional and connected to the MJS401D under normal load.

Otherwise refer to section 11.4 Fault Finding.

If measurements on cards in the main frame indicate correct voltages, it is not necessary to touch the power supply.

To access, fold MJS401D back panel down, but leave all connections intact. Do NOT remove power supply card from back panel!

11.5.1 Adjust +18 V Rail

Connect DVM between +18 V (collector of TR6 or PL1/6) and ground (C14 negative end or PL1/3).

Adjust VR2 for exactly +18 V DC.

11.5.2 Adjust -18 V Rail

Connect DVM between -18 V (collector of TR5 or PL1/5) and ground.

Adjust VR1 for exactly -18 V DC.

11.5.3 Check +5 V Rail

Connect DVM across C17. Confirm voltage is between +4.75 V and +5.25 V DC.

11.5.4 Check Raw Osc Supply

Connect DVM + to C19 positive and - to C19 negative.

Confirm ~54 V D.C. if Osc. not fitted.
~48 V D.C. if Osc. is fitted.

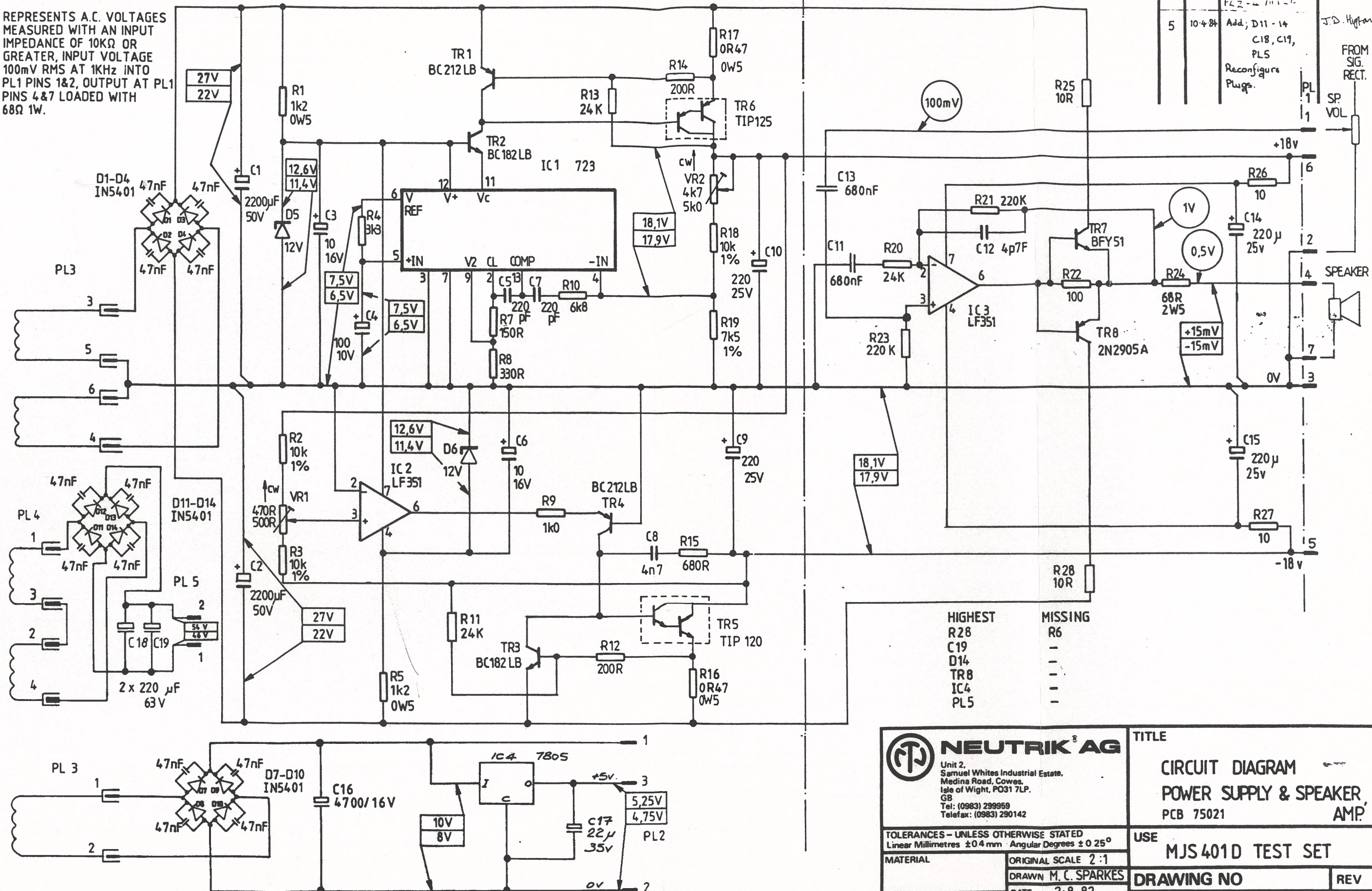
MAXIMUM
MINIMUM

REPRESENTS D.C. VOLTAGES MEASURED WITH A VOLT-METER OF 20,000Ω/V OR GREATER, BETWEEN THE TWO POINTS ARROWED, AT NOMINAL MAINS VOLTAGE, FEEDING A COMPLETE MJS401D. *MAXIMUM IS DEFINED AS MOST POSITIVE VOLTAGE.

REPRESENTS A.C. VOLTAGES MEASURED WITH AN INPUT IMPEDANCE OF 10KΩ OR GREATER, INPUT VOLTAGE 100mV RMS AT 1KHz INTO PL1 PINS 1&2, OUTPUT AT PL1 PINS 4&7 LOADED WITH 68Ω 1W.

POWER SUPPLY

SPEAKER AMPLIFIER



HIGHEST
R28
C19
D14
TR8
IC4
PL5

MISSING
R6
-
-
-
-
-



TITLE
CIRCUIT DIAGRAM
POWER SUPPLY & SPEAKER AMP.
PCB 75021

TOLERANCES - UNLESS OTHERWISE STATED Linear Millimetres ± 0.4 mm Angular Degrees $\pm 0.25^\circ$		USE MJS 401D TEST SET				
MATERIAL	ORIGINAL SCALE 2:1		DRAWING NO			REV
	DRAWN M. C. SPARKES					
	FINISH	DATE 2-8-82		PROJECT NO	TYPE	SHEET NO
CHECKED J. D. H.						
DATE 17 MAY 1983		750	C			
						5

REVISION				APPROVED
NO	DATE	CHANGE		
3	17-5-83	D7-D8 + C10 ADDED		J.D. Higgins
4		L15 C18, C19, PL5 Reconfigure Plugs.		
5	10-4-84	Add; D11-14		

FROM
SIG.
RECT.

SP
VOL

SPEAKER

1V
0.5V

+15mV
-15mV

0V

+18v

-18v

100mV

100mV

100mV

100mV

100mV

100mV

100mV

100mV

100mV

100mV