OPERATING INSTRUCTIONS
FOR

SSG 520

SYNTHESIZED SIGNAL GENERATOR

FARNELL INSTRUMENTS LIMITED · WETHERBY · WEST YORKSHIRE LS22 4DH · TELEPHONE (0937) 61961 · TELEX 55478 FARINT G
REGIONAL OFFICE (SOUTH) · DAVENPORT HOUSE · BOWERS WAY · HARPENDEN · HERTS. AL5 4HX · TEL. (05827) 69071 · TELEX 826307

Section 1 issue 1 7.81

CONTENTS

Amalgamated Loose Leaf Ltd., Ref. CL20

CONTENTS *Section 1 only*

SCHEDULE OF EQUIPMENT

The complete equipment comprises:—

a) 1 off SSG520 signal generator (with options if ordered)

b) 1 off mains cable

c) 1 off lead — b.n.c. to b.n.c.

d) 1 off lead — b.n.c. to open end

e) 1 off N male to b.n.c. female adaptor

f) 1 off 20dB, 50Ω b.n.c. male to b.n.c. female attenuator

g) 1 off mains tap selector card puller

h) 1 off plastic accessory wallet

i) 1 off instruction book

j) 1 off service manual

k) Multipin programme plug (Amphenol 57—30500 50 way) (supplied only if programmability option fitted on unit)

Optional accessories (NOT supplied unless ordered)

1) Padded carrying case (p.v.c.) for protection in transit

2) Hard carrying case (metal) for protection in transit or storage.

3) Rack mounting kit (option E)

INTRODUCTION

The SSG520 is a very easy to use synthesizer with an output range of 10–520MHz and provides full signal generator facilities. The r.f. performance is very good with particularly low leakage levels enabling accurate output level settings to be obtained and the high stability synthesized operation gives precise clean output frequencies.

The output is available via a type N connector and is selectable as a single range with a bank of seven easily read thumbwheel switches. These switches enable the output frequency to be dialled or reset to a resolution of 100Hz very quickly. They may be set in any order at any time and with any frequency step from the smallest (100Hz) to the largest (10 to 520MHz).

Once set the switches act as the generator memory and ensure the instrument will always return to this frequency, without subsequent attention after a power interruption.

L.E.D. lamps provide information regarding the validity of the output frequency. One illuminates when the synthesizer has locked at the requested frequency and another illuminates if an output higher than 520MHz or lower than 10MHz is dialled.

The output level controls are comprehensive with two rotary switches giving a total attenuation range of 119dB in 1dB steps. Dual output scales are provided giving simultaneous indications of voltage pd and dBm (both 50Ω). In addition an output meter gives continuous indication of the presence of r.f. output. The meter, in conjunction with an r.f. fine level control enables the main output attenuator to be calibrated and also gives output level control between the 1dB attenuator steps.

Full modulation facilities are available with four ranges of f.m. and one of a.m. The a.m. and f.m. controls are completely independent allowing them to be set at any level from either the internal two frequency oscillator or an external signal. An internal oscillator output is also provided.

The modulation is monitored by a meter and function select switch. This meter indicates the amount of modulation whether it is derived from internal or external sources.

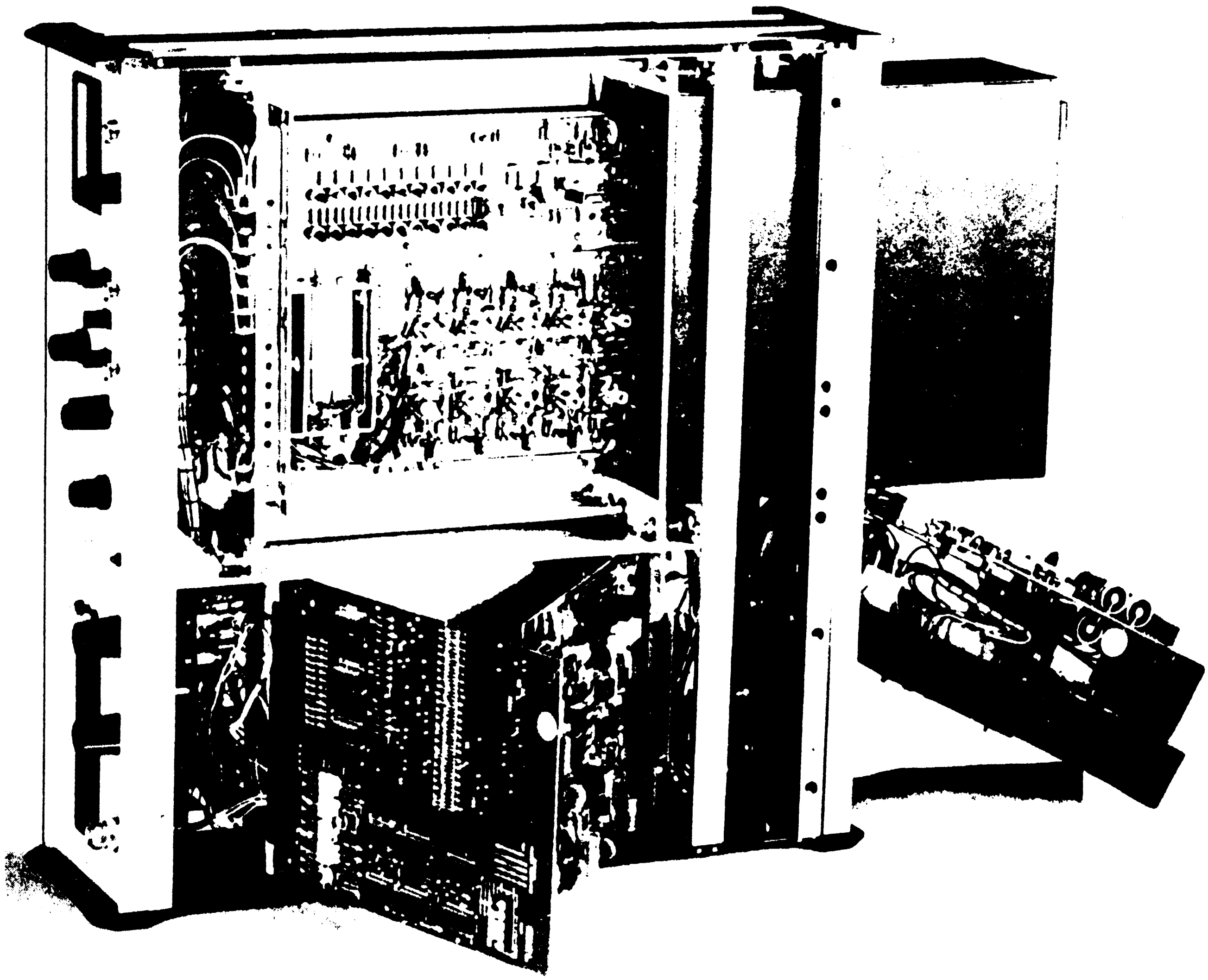
A very useful additional feature is the inclusion of a 1kHz automatic distortion meter. This allows the measurement of receiver SINAD ratios. (The ratio of signal plus noise plus distortion to noise plus distortion). The receiver audio output is automatically level sensed and the 1kHz fundamental removed. The meter then displays the SINAD ratio in dB. No frequency or level tuning is required.

If the remote programme option is fitted then all major functions can be controlled via a multipin socket. These include, frequency, attenuation, modulation and SINAD meter.

Internal reverse power protection is available (option D) and when fitted gives protection against possible attenuator burn-out for up to 50 watts reverse power. The protection automatically resets when the power signal is removed.

Auxiliary features available on the rear panel are the internal crystal reference output, an automatic override external reference input and an input enabling the signal generator to be swept at fast and slow speeds. The rear panel also carries the four position mains voltage tap setting, and the remote programme socket (if fitted).

The engineering is of a very high standard. Special emphasis has been placed on ease of service by making all parts simple to reach and replace. Use has been made of plug-in circuit boards and integrated circuit sockets wherever possible and no special service tools are required.



SPECIFICATION

FREQUENCY RANGE	10 to 520MHz
RESOLUTION	100Hz
STABILITY	As internal or external reference
ACCURACY	As internal or external reference
STABILITY OF INTERNAL CRYSTAL REFERENCE	*Standard:* Ages <2 ppm per year. Temperature coefficient $<3 \times 10^{-7}$ per ^{o}C *Option A:* Ages <1 ppm per year Temperature coefficient $<3 \times 10^{-9}$ per ^{o}C
ACCURACY OF INTERNAL CRYSTAL REFERENCE	*Standard:* $\pm 2\times10^{-6}$ *Option A:* $\pm 2\times10^{-7}$ ex factory at 20^{o}C
FREQUENCY CONTROL	Seven digit thumbwheel switch bank. Most significant digit limited to 5. All others unrestricted rotation.
FREQUENCY LOCK INDICATION	LED lamps confirm lock has been achieved and indicate out-of-range frequency conditions
LOCK AQUISITION TIME	Approximately proportional to frequency step demanded:– 100Hz and 1kHz steps: 200mS typical 10kHz and 100kHz steps : 2 secs typical 1MHz, 10MHz and 100MHz steps : 10 secs typical
OUTPUT LEVEL	0dBm into 50Ω (224mV r.m.s. pd) with attenuation down to -119 dBm (0.2μV r.m.s. pd) in 1dB steps. In addition a continuous fine control is provided giving a range of at least + 6dB to – 3dB and a carrier off facility
OUTPUT ACCURACY	±1dB at an output level of 0dBm from 10 to 520MHz
ATTENUATOR ACCURACY	±0.2dB for any 1dB step ±2dB for any 10dB step

SOURCE IMPEDANCE	50Ω.
HARMONIC CONTENT	Less than 25dB
RESIDUAL A.M.	Less than 0.5%
RESIDUAL F.M.	Approximately proportional to frequency. Measured in 15kHz f.m. bandwidth. Less than 20Hz peak deviation at 10 MHz. Less than 300 Hz peak deviation at 520 MHz.
CARRIER LEAKAGE	Less than 0.5μV induced in 2 turn 1" diameter loop 1" away from any surface of signal generator. Loop connected to 50Ω receiver.
A.M. DEPTH	0 to 90%
A.M. ACCURACY	±10% of reading ±5% of f.s.d.
A.M. BANDWIDTH	20Hz to 50kHz (2dB)
A.M. DISTORTION	Less than 1.5% at 30% depth 1kHz Less than 5% at 80% depth 20Hz–50kHz
EXTERNAL A.M. INPUT	1V r.m.s.
EXTERNAL A.M. INPUT IMPEDANCE	>5kΩ a.c. coupled
F.M. DEVIATION	0–3–10–30–100kHz peak
F.M. ACCURACY	±10% of reading ±5% of f.s.d. > 30MHz ±15% of reading ±10% of f.s.d. < 30MHz
F.M. BANDWIDTH	20Hz to 50kHz (2dB)
F.M. DISTORTION	Less than 1.5% 100kHz peak deviation, 1kHz Less than 3% 100kHz peak deviation, 20Hz to 50kHz
EXTERNAL F.M. INPUT	1V r.m.s.
EXTERNAL F.M. INPUT IMPEDANCE	> 5kΩ a.c. coupled

INTERNAL OSCILLATOR FREQUENCIES	1kHz and 400Hz
INTERNAL OSCILLATOR OUTPUT LEVEL	1V r.m.s.
INTERNAL OSCILLATOR OUTPUT IMPEDANCE	Less than 100Ω. Load >1kHz a.c. coupled
INTERNAL OSCILLATOR DISTORTION	Less than 0.5%
A.M. ON F.M.	Less than 2% for 50kHz peak deviation
F.M. ON A.M.	Less than 20 ppm
SINAD INPUT FREQUENCY	1kHz (tracks with internal 1kHz modulation oscillator)
SINAD INPUT LEVEL	50mV r.m.s. to 3V r.m.s.
SINAD INPUT IMPEDANCE	>5kΩ a.c. coupled
SINAD MEASUREMENT RANGE	6 to 30dB
EXTERNAL SWEEP INPUT	−5V to +5V gives at least +1MHz to −1MHz dispersion
EXTERNAL SWEEP INPUT IMPEDANCE	>5kΩ d.c. coupled
LOCK DISABLE INPUT	CMOS (+15V). 0V to disable synthesizer, d.c. coupled
INTERNAL REFERENCE FREQUENCY	2MHz
INTERNAL REFERENCE OUTPUT LEVEL	CMOS (0 to +15V) d.c. coupled
EXTERNAL REFERENCE FREQUENCY	1MHz
EXTERNAL REFERENCE INPUT LEVEL	1 to 15V peak to peak square wave
EXTERNAL REFERENCE IMPEDANCE	>5kΩ d.c. coupled

INTERNAL REVERSE POWER PROTECTION (option D)	If fitted gives protection against attenuator burn-out up to 50 watts reverse power. Protection automatically resets when power signal removed.
PROGRAMMABILITY (option B)	If fitted, gives remote control of frequency (7 digits), attenuation (10 and 1dB steps) and modulation (on/off). Outputs are also provided of synthesizer 'locks', 'overrange' and 'underrange' lamps, SINAD a.g.c. lamp, SINAD meter reading and necessary power rails
OPERATING AMBIENT TEMPERATURE RANGE	0 to 40°C
MAINS SUPPLY REQUIREMENT	100, 120, 220, 240V a.c. Tolerance +6 to −10% 48 to 440Hz. 30VA approx.
MAINS FUSE	250mA for 220 and 240V a.c. 500mA for 100 and 120V a.c.
MAINS CABLE	Detachable. Fitted with standard three pin C.E.E. approved connector
DIMENSIONS/WEIGHT	Height 137 mm Width 440 mm Depth 440 mm Weight 13.8 kg
SHIPPING WEIGHT/ BOX SIZE	Weight 17 kg Height 230 mm Width 570 mm Depth 570 mm
ACCESSORIES (supplied free with instrument)	Mains cable Lead – b.n.c. to b.n.c. Lead – b.n.c. to open end N male to b.n.c. female adaptor 20dB, 50Ω b.n.c. male to b.n.c. female attenuator Mains tap selector card puller Plastic accessory wallet Instruction book Service manual

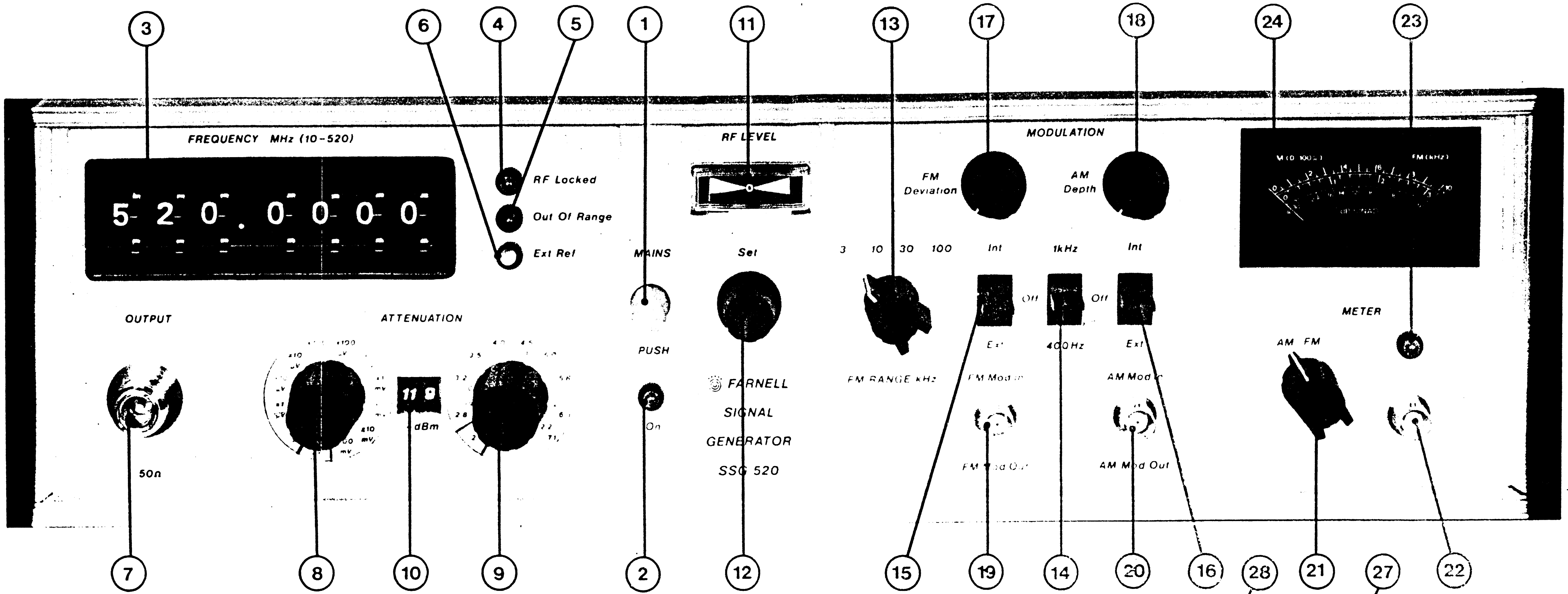
IDENTIFICATION OF CONTROLS ETC.

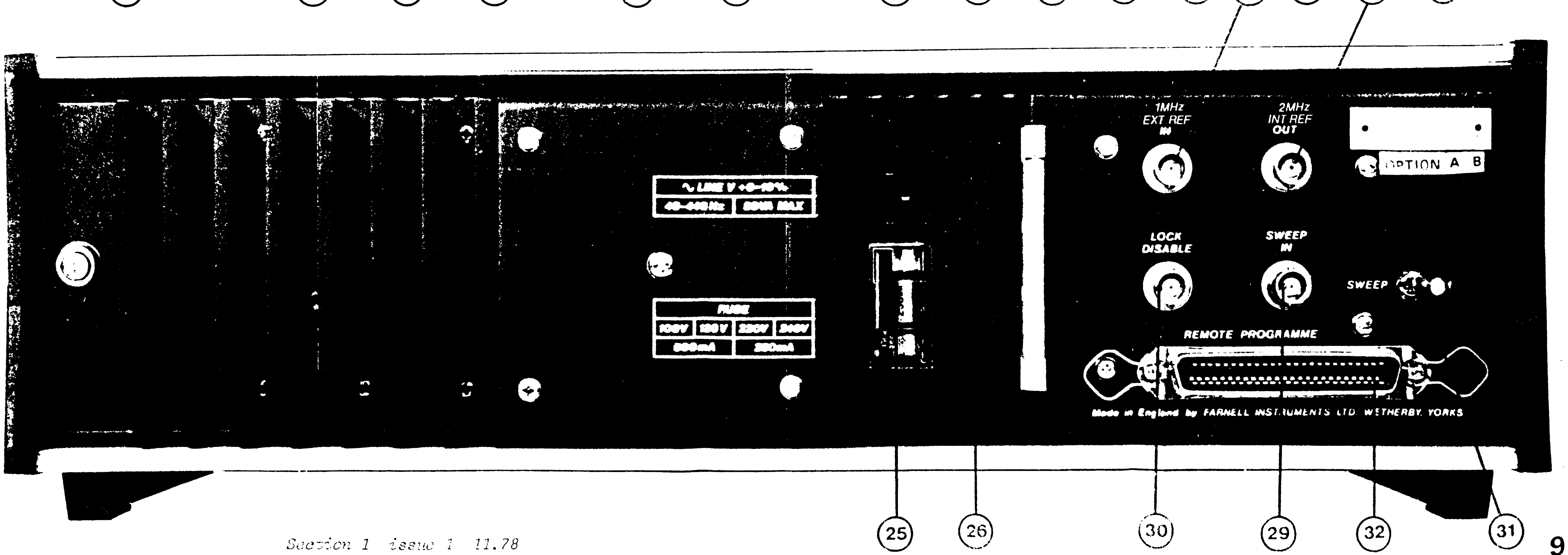
Front Panel

1) Mains switch. Push on/off.
2) Mains on indication L.E.D. lamp.
3) Bank of seven thumbwheel switches setting output frequency
4) Lock lamp. L.E.D. illuminates when output frequency is locked to crystal reference
5) Out of range lamp. L.E.D. illuminates when thumbwheels set out of instrument frequency range
6) External reference lamp. L.E.D. illuminates when instrument has external reference source connected.
7) R.F. output connector. Type N 50Ω
8) R.F. output attenuator. 10dB steps. Scale carries colour coded multiplier for 1dB step voltage scale
9) R.F. output attenuator. 1dB steps. Scale carries colour coded voltage scale (pd, 50Ω) to be multipliedby scale on 10dB step attenuator
10) dBm output level. In the window can be seen the instrument r.f. output level in –dBm, 50Ω
11) R.F. output level meter
12) **R.F. output level adjustment control and carrier off switch. Calibrates output attenuator scales and allows interpolation between 1dB steps.**
13) F.M. range switch giving four sensitivity settings
14) Internal oscillator switch. Three positions giving 1kHz, 400Hz and off
15) F.M. select switch. Three positions giving choice of internal modulation source, external source or off.
16) A.M. select switch. Three positions giving choice of internal modulation source, external source or off.
17) F.M. deviation control
18) A.M. depth control
19) B.N.C. socket allowing the connection of an external f.m. source. Also doubles as the internal audio oscillator output.
20) B.N.C. socket allowing the connection of an external a.m. source. Also doubles as the internal audio oscillator output.
21) Meter select switch. Sets the meter to read modulation, internal or external, and the SINAD ratio.
22) B.N.C. input for SINAD measurements
23) SINAD input a.g.c. L.E.D. illuminates when input is within a.g.c. range.
24) Meter. Calibrated for a.m. depth, f.m. deviation and SINAD ratio.

Rear Panel

25) Sliding window covering mains tap select card and mains fuse
26) Mains input connector. Standard three pin C.E.E. approved type
27) Internal crystal reference output socket
28) External reference frequency input socket
29) B.N.C. socket enabling connecton of an external source to sweep the r.f. output
30) B.N.C. socket allowing the r.f. synthesizer lock mechanism to be temporarily suspended at the last frequency for slow sweeping
31) Two position locking switch for the selection of f.m. operation (front panel controls) or sweep operation (rear panel controls)
32) Multiway programme socket (if fitted)


FREQUENCY MHz (10-520)
520.0000
RF Locked
Out Of Range
Ext Ref
RF LEVEL
MAINS
PUSH
On
Set
MODULATION
FM Deviation
AM Depth
3 10 30 100
Int
Off
1kHz
Off
Int
Ext
400Hz
Ext
FM RANGE kHz
FM Mod In
AM Mod In
FM Mod Out
AM Mod Out
OUTPUT
50Ω
ATTENUATION
dBm
FARNELL
SIGNAL
GENERATOR
SSG 520
METER
AM FM
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24


1MHz EXT REF IN
2MHz INT REF OUT
OPTION A B
LOCK DISABLE
SWEEP IN
SWEEP
REMOTE PROGRAMME
FUSE
Made in England by FARNELL INSTRUMENTS LTD WETHERBY YORKS
25 26 27 28 29 30 31 32

OPERATING INSTRUCTIONS

Unpacking

The instrument has been carefully packed to prevent damage in transit. When removing the unit from the packing box, be sure that all parts and accessories are removed from the packing material. As soon as the instrument is unpacked, it should be inspected for possible transit damage.

In the event of damage in transit or shortage in delivery, separate notice in writing should be given to both the carriers and Farnell Instruments Limited, within three days of receipt of the goods, followed by a complete claim within five days. All goods which are the subject of any claim for damage in transit or missing items should be preserved intact as delivered, for a period of seven days after making the claim, pending inspection or instructions from Farnell Instruments Limited, or an agent of this Company.

Initial setting up

Check the mains input setting is correct for the local supply by looking through the clear window below the mains input socket on rear panel.

One of four alternative settings will be visible. Should it be necessary to change the setting, slide the window upwards remove the fuse and then pull out the small selector card using the puller provided.

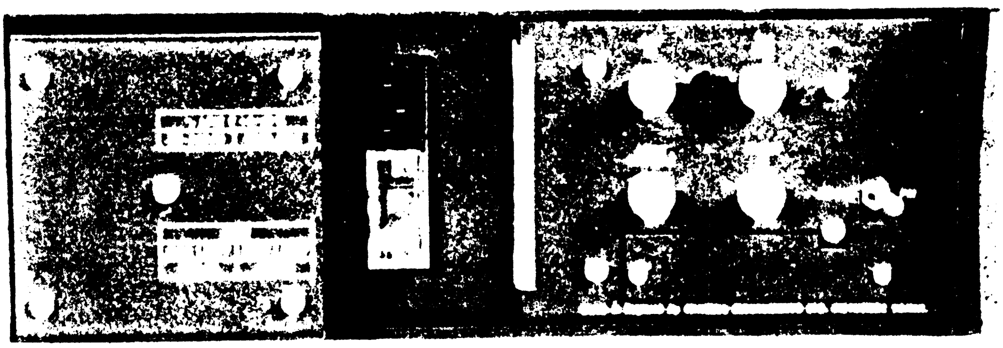
Re-insert the card in the appropriate alternative position so that the required voltage setting is visible when the card is fully replaced. Replace the fuse ensuring the rating is correct for the mains voltage to be used and slide down the window.

Connect a suitable mains plug to the mains cable observing the following colour code:–

Live	–	Brown
Neutral	–	Blue
Earth	–	Green/Yellow

Plug mains cable into socket on rear of instrument and to power source.

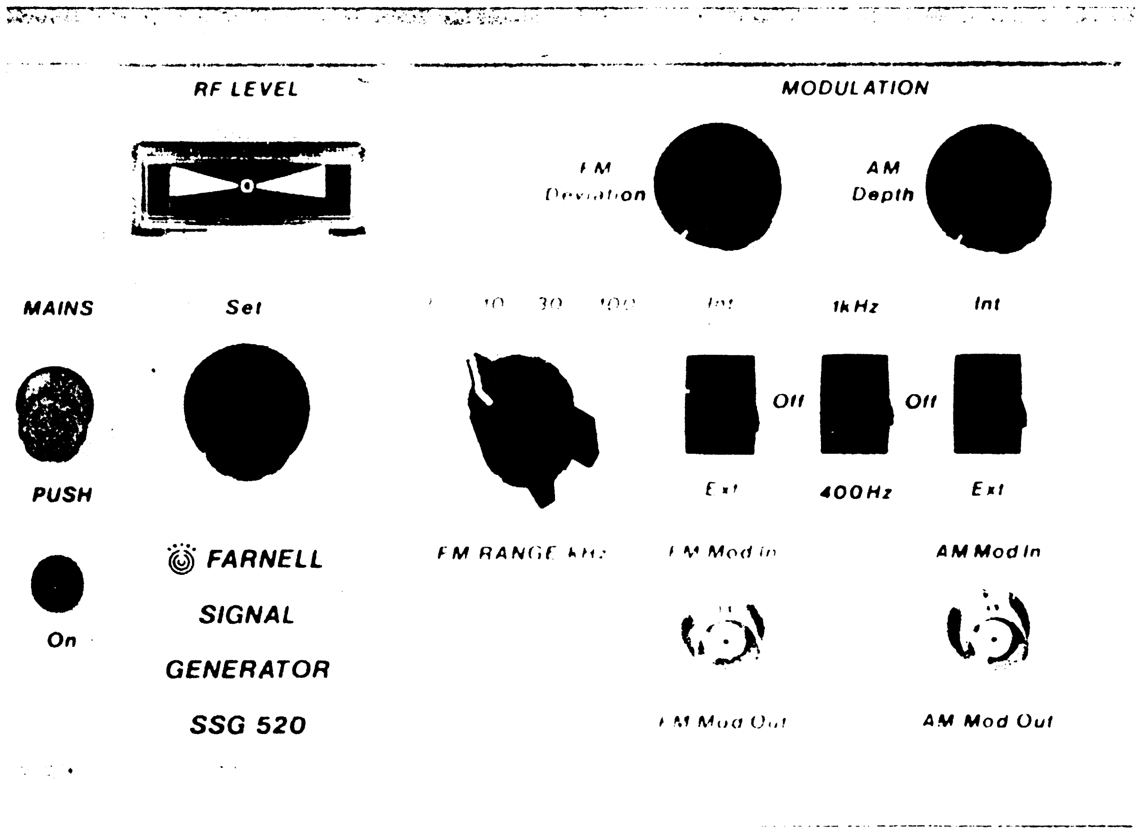
Check that the rear panel self-locking switch is set to 'FM'. Pull the switch lever outwards to unlock it for resetting. The spring loaded lever will re-lock itself.



Turn off the three modulation select switches by putting them in the central position.

Press the mains push-button. The mains l.e.d. will light.

Using the r.f. level 'Set' control set the output level meter to read centre scale.



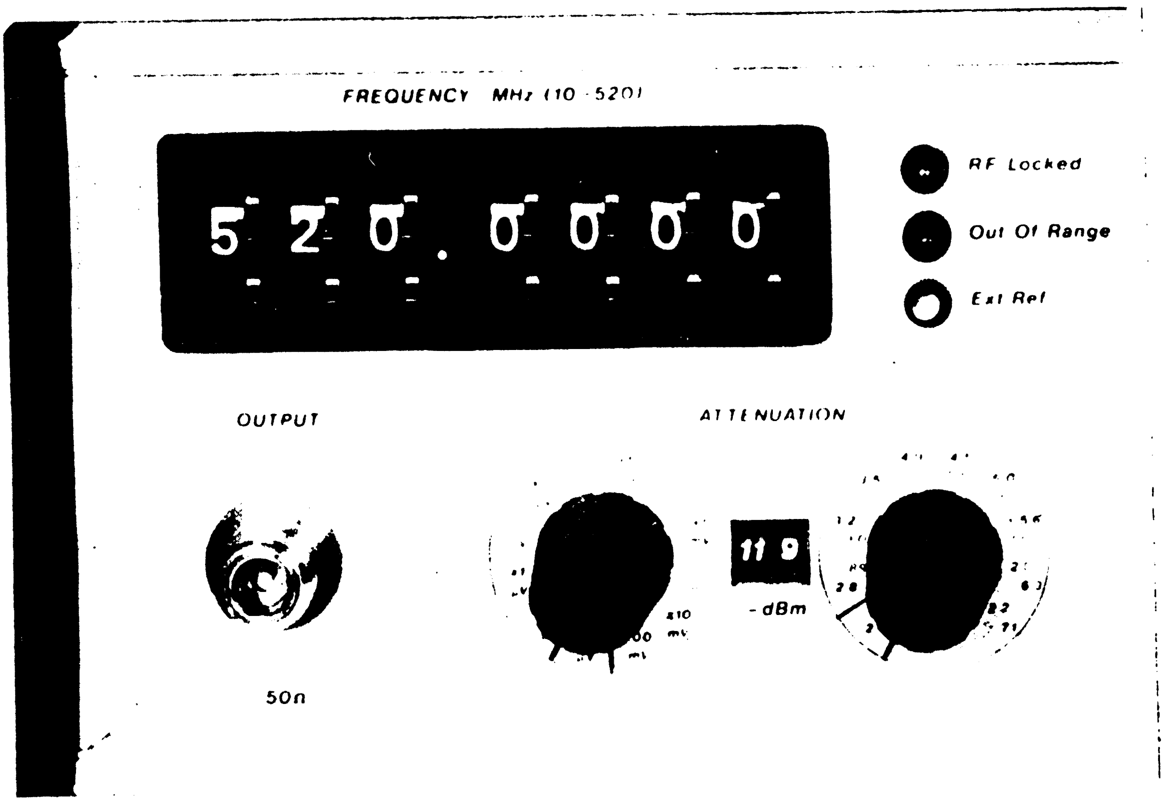
Frequency

Select the required output frequency on the seven section thumbwheel switch bank. The segments may be set in any order at any time. The hundreds of megahertz digit is mechanically stopped at 0 and 5 but all other decades can be continuously rotated either up or down in frequency. The instrument is auto frequency ranging so any frequency step can be demanded.

The green r.f. lock lamp will extinguish whilst the frequency is being found and illuminate continuously when lock has been achieved. The time required to perform a frequency change depends mainly upon the step size. A step of 1MHz or larger will initiate an automatic calibration of the frequency modulation and sweep. (Patent applied for). This calibration results in two brief 'blinks' of the lock lamp prior to final lock being achieved although in some cases the second 'blink' is so close to the lock lamp finally illuminating continuously it cannot be perceived.

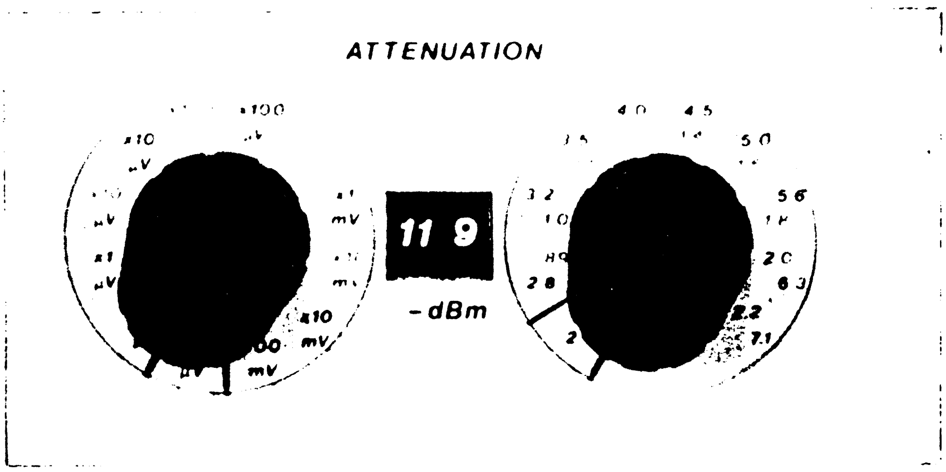
A red, 'out of range' l.e.d. will illuminate if the thumbwheels are set to a figure higher than 520.9999 or lower than 10.0000. The synthesizer remains operative however, so lock may be obtained outside these limits. It is in order to use the instrument under these conditions although the specifications will not apply.

Because the most significant digits have the longest lock time it is both convenient and quickest to set a new frequency starting with these digits and proceeding down to the least significant figures.



Output level

The r.f. level 'set' control is used initially to calibrate the step attenuator scales. Adjust the 'set' control until the output edge-meter is reading centre scale. The 10dB and 1dB step attenuators may then be used to obtain the desired output level. There are two level scales on the attenuators, giving readings in dBm and volts pd (both 50Ω). The dBm figure is readable directly in the window between the attenuator controls and the voltage figure is obtained from both the scales surrounding the attenuator controls. The left hand 10dB step scale shows a multiplier reading. A colour code has been incorporated because each 1dB step carries two voltage figures – one in red, the other in black. Use the figure which is the same colour as the multiplier shown by the 10dB step attenuator.



The carrier may be switched off without disturbing the attenuator setting or lock condition by rotating the 'set level' control to the extreme left to operate the integral 'carrier-off' switch.

For level adjustments between the 1dB steps provided by the main attenuator, the 'set level' control may be used. Away from the centre scale position the a.m. performance may be impaired but other functions remain unaffected. Limited amounts of a.m. may be used however with the meter set away from centre scale thus enabling a.m. to be applied at output levels greater than 0dBm. For example, with the meter set at 75% f.s.d. approx. 50% a.m. will be available.

Another function of this control is to provide up to twice the normal output level (i.e. +6dB). This is obtained when the meter is set to f.s.d. No a.m. performance will be obtainable under these conditions.

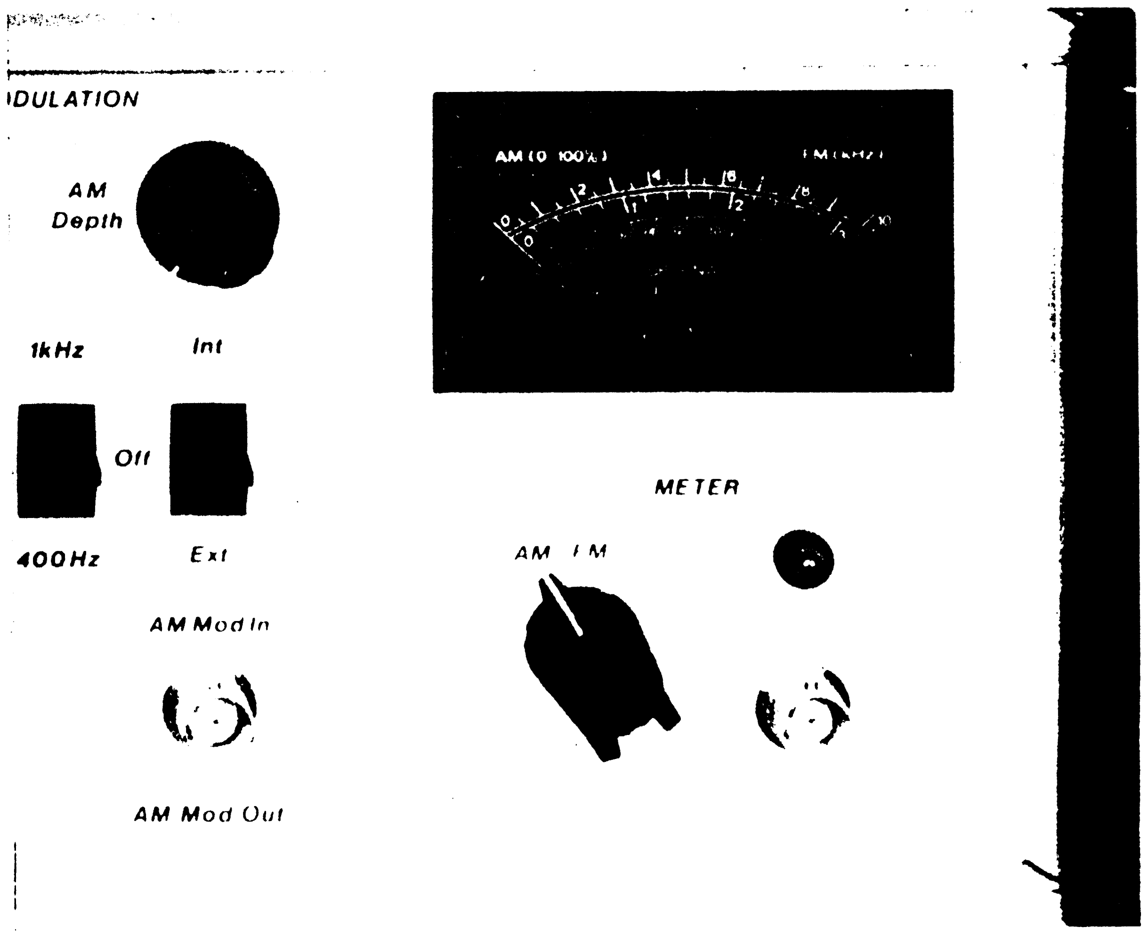
The 'set' control is operable at all r.f. levels obtained by the use of the step attenuator and so can be used to obtain less than the calibrated minimum attenuator output of 0.2μV.

Amplitude modulation

The controls associated uniquely with a.m. are colour coded blue. Set the meter to read a.m. by switching the meter select switch to 'AM'. Switch the internal oscillator on by selecting either 1kHz or 400Hz frequency. If an external modulation source is to be used the internal oscillator may be left off although this is not essential.

Select either internal or external modulation. If internal modulation is being used adjust the a.m. depth control until the meter indicates the desired modulation depth. The internal oscillator frequency will be available at the internal a.m. output b.n.c.

For external modulation connect the external source to the a.m. input b.n.c. at a level of 1V r.m.s. Use the a.m. depth control and meter as above. If the level of the external source is not known adopt the following procedure to avoid overdriving the input amplifier. Set a.m. depth control fully clockwise. Increase the level of the external signal until the meter reads f.s.d. Use the a.m. depth control to set the required depth on the meter.

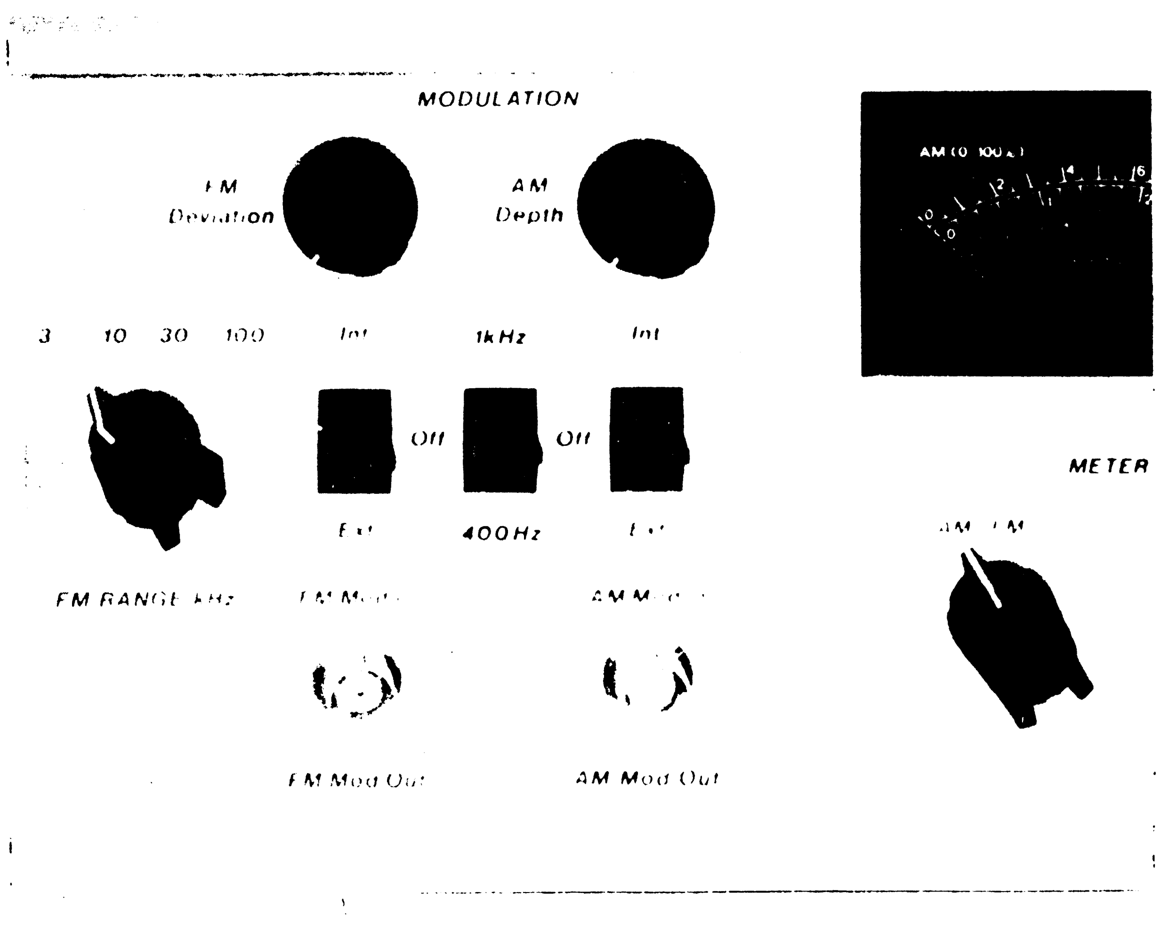


Frequency modulation

The controls associated uniquely with f.m. are colour coded green. Set the meter to read f.m. by switching the meter select switch to 'FM'. Switch the internal oscillator on by selecting either 1kHz or 400Hz frequency. If an external modulation source is to be used the internal oscillator may be left off although this is not essential.

Select either internal or external modulation. Using the f.m. range switch select the meter f.s.d. most suitable for the deviation to be used. If internal modulation is being used adjust the f.m. deviation controls until the meter indicates the desired peak deviation. The internal oscillator frequency will be available at the internal f.m. output b.n.c.

For external modulation connect the external source to the f.m. input b.n.c. at a level of 1V r.m.s. Use the f.m. deviation control and meter as above. If the level of the external source is not known adopt the following procedure to avoid overdriving the input amplifier. Set the f.m. deviation control fully clockwise. Increase the level of the external signal until the meter reads f.s.d. Use the f.m. deviation control to set the required deviation on the meter.



Multiple modulation

Since the a.m. and f.m. circuits are equipped with individual selection and level controls, then any combination of simultaneous a.m. and f.m. is possible. The sources can be internal, external or both with each type of modulation separately set and metered.

SINAD measurements

The controls associated uniquely with the SINAD metering function are colour coded **orange**.

The term SINAD is derived from the expression:—

SIgnal plus Noise And Distortion. The SINAD ratio, expressed in dB, is given by the following equation:—

$$\text{dB SINAD} = 20 \log_{10} \frac{(\text{Signal} + \text{Noise} + \text{Distortion})}{(\text{Noise} + \text{Distortion})}$$

The SINAD meter in the SSG520 is designed to directly measure the SINAD ratio of a 1kHz signal. It does this by applying a wide range a.g.c. to the signal to fix the value of the numerator in the above equation to a constant, say C.

$$\text{Thus} \quad \text{dB SINAD} = 20 \log_{10} \frac{C}{(\text{Noise} + \text{Distortion})}$$

$$\text{or} \quad \text{dB SINAD} \propto \log_{10} \frac{1}{(\text{Noise} + \text{Distortion})}$$

The 1kHz fundamental is then notched out and the remainder (i.e. the denominator in the above equation) displayed on the meter. Since the meter has a reciprocal logarithmic scale:—

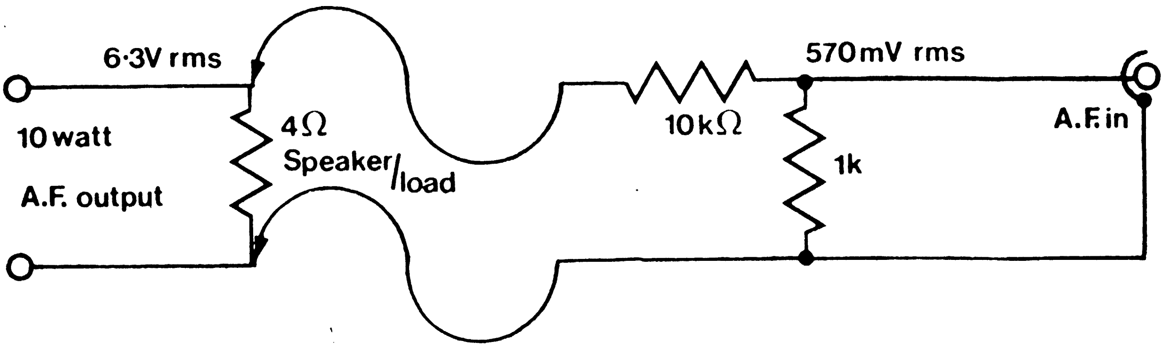
$$\text{dB SINAD} \propto \text{meter reading}$$

The most common SINAD measurement is the 12dB SINAD sensitivity of f.m. receivers. To measure this, the SSG520 r.f. output is connected to the receiver aerial input and a strong signal injected with the frequency set to correspond to the appropriate channel frequency. The generator signal should be frequency modulated at 1kHz using the internal facility provided. This is because the SINAD meter 1kHz notch filter has been adjusted to follow the internal 1kHz oscillator.

Set the meter function switch to 'SINAD' after the modulation has been set up. Connect the SINAD 'AF IN' b.n.c. socket to the receiver loudspeaker terminals (or dummy audio load).

If the whole receiver is being evaluated, set the audio output to the maximum rated power. If the r.f. circuits only are of concern the audio output may be set at a comfortable level.

Adjust the audio output level if necessary so that the green SINAD a.g.c. l.e.d. is illuminated. This indicates the input level is within the instrument measurement range. When working at maximum rated output power, it may be necessary to attenuate the 1kHz by means of a simple resistive divider to bring the level within the a.g.c. range. An example is shown below.



If the receiver is operating normally a low SINAD meter deflection will occur. A high reading would indicate distortion is present.

The r.f. signal is then progressively reduced using the SSG520 output attenuator until the SINAD reading rises to 12dB. The output attenuator reading is then the 12dB SINAD sensitivity of the receiver. If the reading is much higher than expected it indicates a high r.f. output noise content.

The major advantage of a SINAD ratio meter is that it enables assessment of noise or distortion content, or both, since it is the combination of these which affects the final speech intelligibility.

An important note is that it is best to use the internal 1kHz source, since this has been designed to always fall within the SINAD meter filter. An external 1kHz may be used however provided that it can be tuned to give minimum SINAD meter deflections.

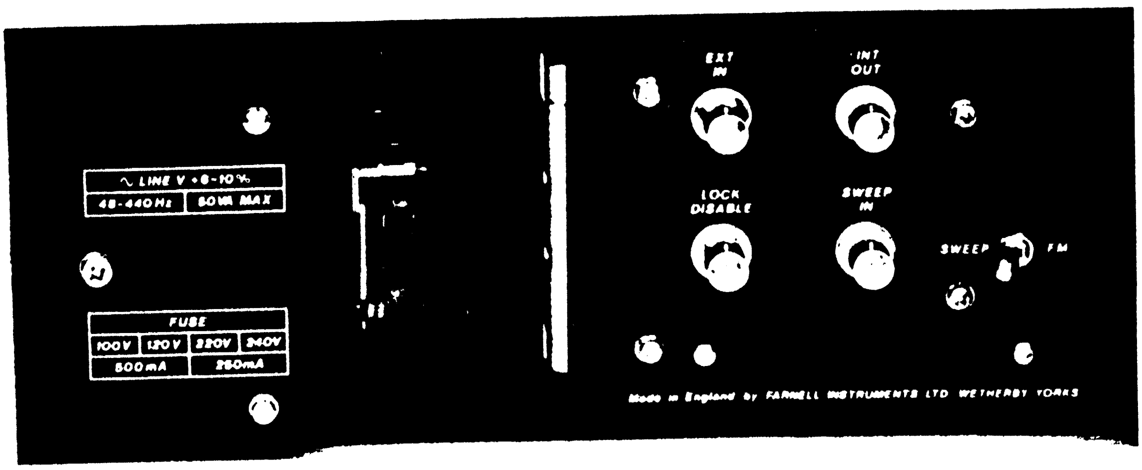
Sweeping

The signal generator may be swept, whilst under locked conditions up to a maximum of ±1MHz peak deviation. The sweep input is located on the back panel and is selected by the self-locking switch. The switch lever must be pulled out to unlock for resetting. The sweep input is d.c. coupled and so there is no lower limit to the speed at which the r.f. oscillator can be swept. However, as the sweep rate is reduced below 20Hz, the synthesizer will progressively remove the effect of the sweep voltage.

Under these conditions, the sweep disable input on the back panel must be utilised if constant sweep dispersion is to be obtained. The disable control allows the synthesizer output voltage, which drives the r.f. oscillator, to be held constant while the sweep signal is being applied. In this state, the r.f. oscillator will be subject to normal free-running oscillator frequency drift, so it will be necessary to periodically release the disable input to allow the synthesizer to re-establish the correct centre frequency. This is best done at the end of each sweep, thus ensuring there is a frequency re-calibration at every sweep, although at wider sweep dispersions and higher sweep speeds, drift will not be a problem and the frequency re-locking can be done less frequently.

In use the rear panel self-locking switch is set to 'sweep' and the synthesizer first allowed to lock at the required centre frequency, and then disabled. Sweep may then be applied at the rear panel input and the synthesizer enabled periodically as and when necessary. The synthesizer can be set to another frequency during the sweep operations but it will only be operative of course when not disabled.

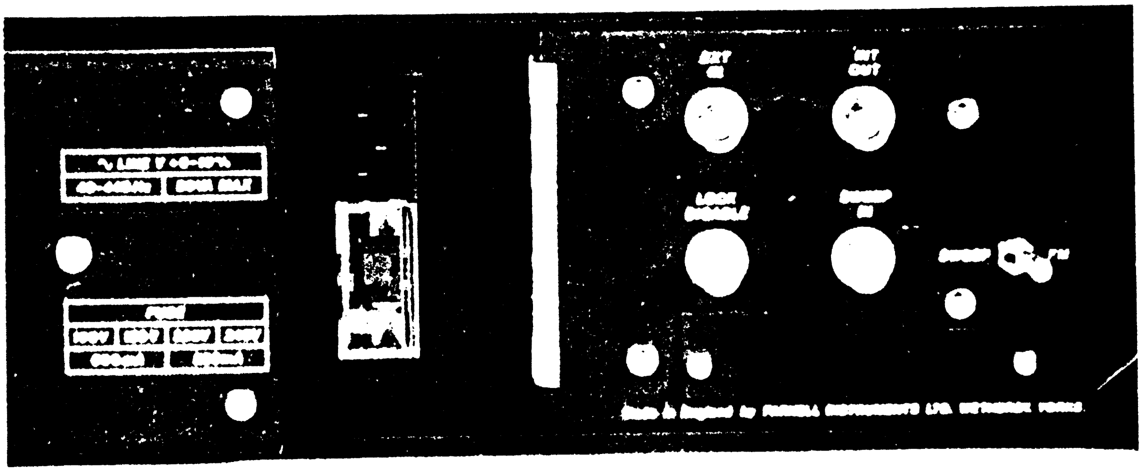
At sweep rates below 20Hz, the 'RF Locked' lamp may extinguish. This is because the synthesizer is working against the sweep signal to a certain extent and so gives out of lock indication. Provided lock is achieved before sweep commenced, the lamp can be ignored.

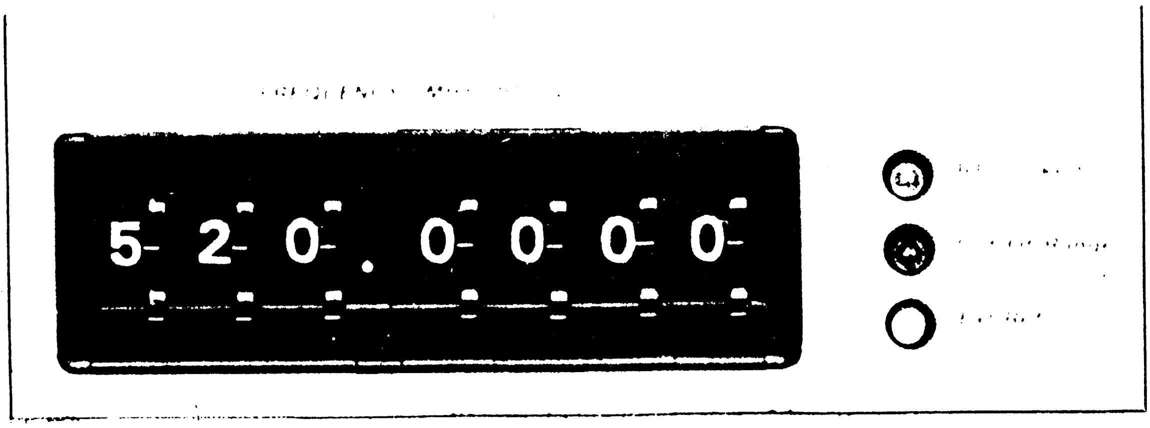


Frequency reference

The internal crystal frequency reference is available via a rear panel b.n.c. socket. An external source may be used and should be connected to the rear panel input socket. The presence of this external signal will automatically change over the SSG520 reference source from internal to external. The front panel l.e.d. indicator lamp will illuminate.

The internal reference frequency is always available, whether using internal or external reference.





MAINTENANCE

Guarantee

The equipment supplied by Farnell Instruments Ltd. is guaranteed against defective material and faulty manufacture for a period of twelve months from the date of despatch. In the case of material or components employed in the equipment but not manufactured by us, we allow the customer the period of any guarantee extended to us.

The equipment has been carefully inspected and submitted to comprehensive tests at the factory prior to despatch. If, within the guarantee period, any defect is discovered in the equipment in respect of material or workmanship and reasonably within our control, we undertake to make good the defect at our own expense subject to our standard conditions of sale. In exceptional circumstances and at the discretion of the Service Manager, a charge for labour and carriage costs incurred may be made.

Our responsibility is in all cases limited to the cost of making good the defect in the equipment itself. The guarantee does not extend to third parties, nor does it apply to defects caused by abnormal conditions of working, accident, misuse, neglect or wear and tear.

Maintenance

In the event of difficulty, or apparent circuit malfunction, it is advisable to telephone (or telex) the Service Department or your local Sales Engineer or Agent (if overseas) for advice before attempting repairs.

For repairs and re-calibration it is recommended that the complete instrument be returned to:—

FARNELL INSTRUMENTS LIMITED
SANDBECK WAY · WETHERBY
WEST YORKSHIRE LS22 4DH
TELEPHONE (0937) 61961
TELEX 557294 FARIST G

or

REGIONAL OFFICE (SOUTH)
TELEPHONE: HARPENDEN (05827) 69071
TELEX: 826307 FARINT G

Please ensure adequate care is taken with packing and arrange insurance cover against transit damage or loss.

OVERALL SYSTEM DESCRIPTION

The SSG520 employs a single frequency/phase lock loop operating with 11 voltage controlled oscillators (VCO's), the highest of which uses resonant striplines in a tank circuit. Only one oscillator is operating at any one time, the selection being performed by the range control. The three most significant digits of the frequency selected by the thumbwheels are decoded by the range control board into one of eleven ranges. This range data is passed to the r.f. enclosure in four line binary form, there it is decoded by the range decoder into one of eleven for selection of the appropriate VCO.

The combined synthesizer and prescaler board contains a seven decade programmable divider chain operating on the output of the selected VCO and dividing it by the number set up on the thumbwheel switches. Due to its high toggling speed and r.f. radiation the prescaler board is positioned in the r.f. box separate from the synthesizer board. The synthesizer also contains a fixed divider chain to divide the two megahertz signal from the crystal reference board down to the 100 hertz comparison frequency. The crystal reference chain output and the programmable chain output are compared on the synthesizer board and any difference fed to the VCO's by the tuning line in order to correct the frequency. The tuning line is permanently connected to all the VCOs but will, of course, only influence the selected one.

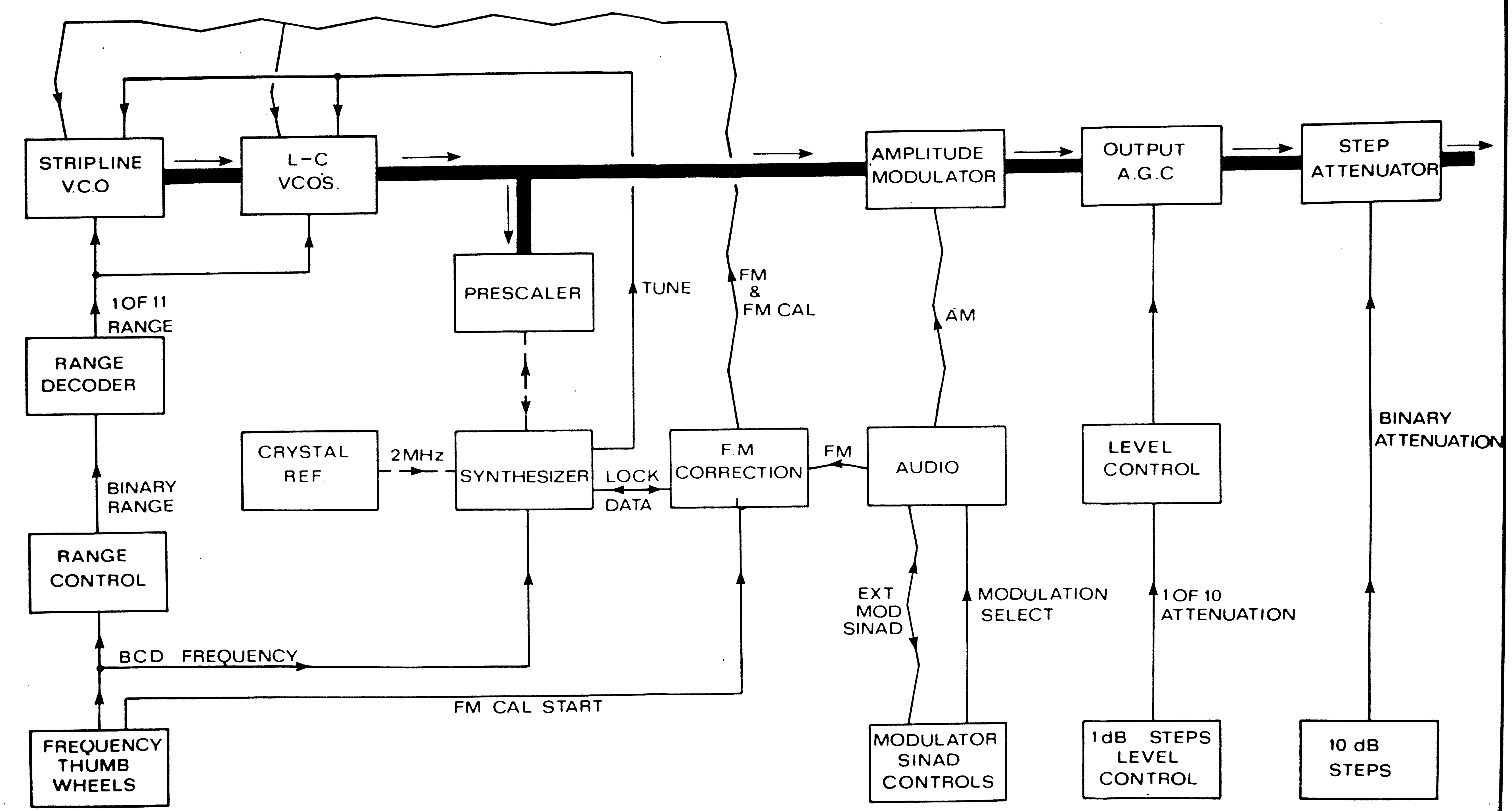
Any change of data from the three most significant digits on the thumbwheels causes an f.m. calibration start signal to be passed to the f.m. correction board. This board utilises the synthesizer to find two frequencies one megahertz apart one of which is the required final frequency. It uses both VCO tune line and the VCO f.m. input line for this purpose. The sensitivity of the VCO to f.m. is thus sensed and the f.m. signalled from the audio board can be attenuated by the correct amount before passing along the f.m. line to the r.f. oscillators. The f.m. line is permanently connected to all eleven VCOs.

The audio board contains the internal modulation oscillators and SINAD measurement functions. Audio signals are selected and passed to the amplitude modulator or frequency modulation correction board as appropriate. Buffer amplifiers are positioned between functions for calibration and isolation purposes. There are meter detection circuits for modulation and SINAD display.

In the r.f. chain after the VCOs are: an amplitude modulator, output amplifier with a.g.c. and a 10dB step attenuator. The output a.g.c. has three uses. First it provides output levelling, second it is used as the fine output level vernier control and third the 1dB steps are provided by stepping the a.g.c. level in a logarithmic sequence. The first two functions are provided by the level control section located on the range control board. The 1dB steps are controlled from the front panel. The output step attenuator is selected by binary data from the front panel control.

USED ON

DRAWING No. 3ZV0832282



TRACED				
CHECKED		C	9 Nov 78	Q5082
		B	22.8.78.	Q4919
DRAWN	J.N.	ISS	DATE	MOD No.
		A	19.6.78	—

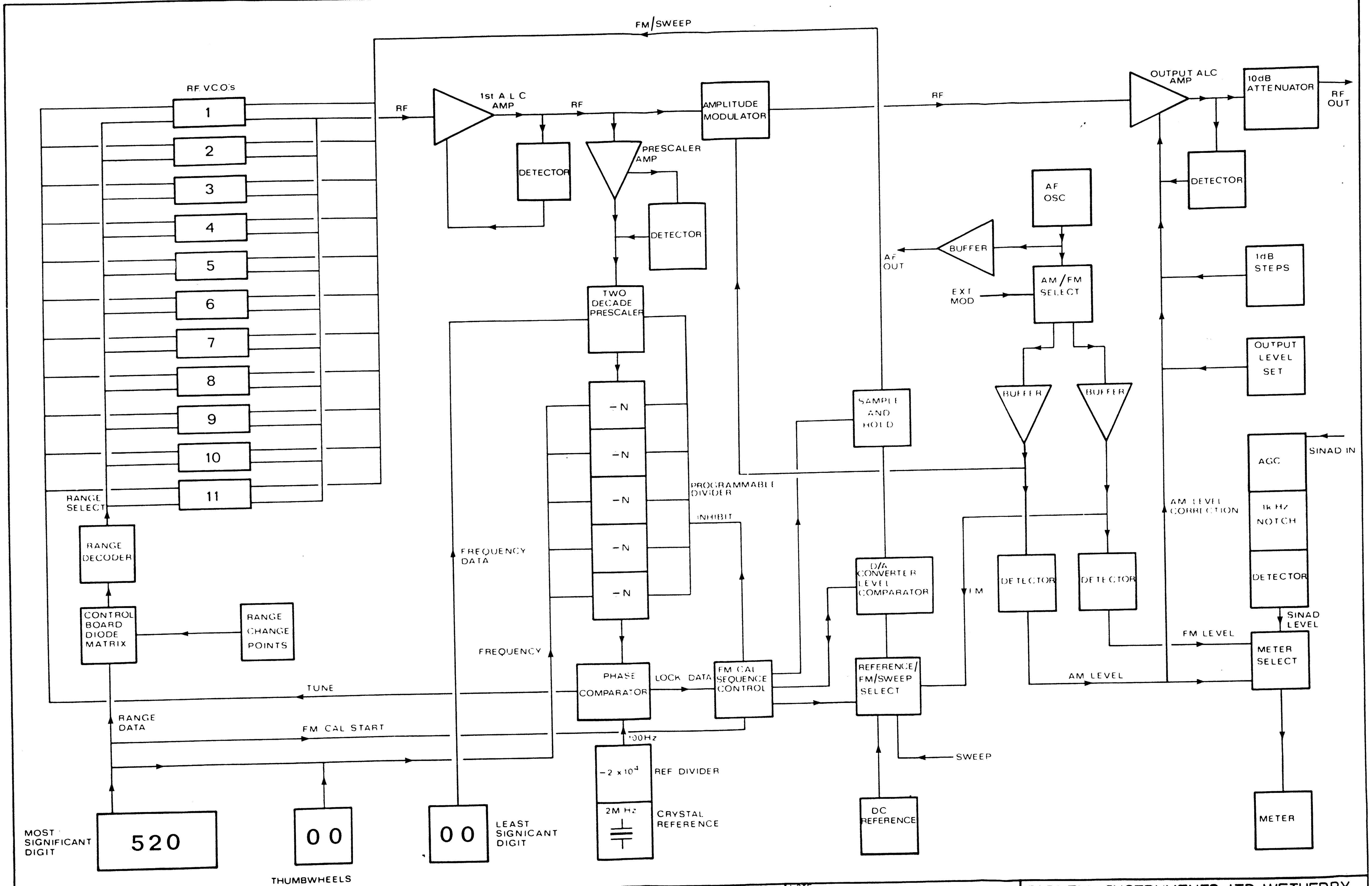
▬ = RF | = DC ¦ = DIGITAL 〉 = AF

FARNELL INSTRUMENTS LTD. WETHERBY.

TITLE: OVERALL BLOCK DIAGRAM SSG520

DRAWING No. 3ZV0832282

Section 2 issue 1 11·78



TRACED	ISS	DATE	MOD NO	ISS	DATE	MOD NO
	A	24 11 78				
CHECKED						
DRAWN AM						

USED ON
F832

NOTE
CAPACITORS VALUES GIVEN IN
RESISTOR VALUES IN
UNLESS OTHERWISE STATED

FARNELL INSTRUMENTS LTD WETHERBY

TITLE DETAILED BLOCK DIAGRAM

Section 2 issue 1 11·78

DRAWING NO 2ZVO832285

SHEET 1 OF 1 SHEETS

THE R.F. OSCILLATORS

1. *Stripline oscillator assembly*

The highest frequency oscillator (range eleven) is formed around a common source f.e.t. Feedback for oscillation is by gate and drain inductive lines coupled magnetically. The two coupled lines grounded at one end are less than a quarter wave length long and so appear inductive. This inductance resonates with capacitance diodes connected to the line ends. The use of a double tuned system increases the tank Q and thus lowers oscillator noise.

Tuning is accomplished by reverse biasing all the varactors with a voltage applied to the cathodes. Frequency modulation is performed by applying the audio signal to two of the reactor anodes suitably attenuated by a resistor potential divider so the varactors are never forward biased. A 'hard start' circuit fitted in the supply line forces the oscillator supply to maximum when first turned on and then slowly reduces it to the correct bias point. This minimises initial frequency drift and ensures accurate f.m. calibrations when range changing.

The r.f. output is taken from an auxiliary line coupled to the drain line.

2. *Oscillator board*

The oscillator board contains ten separate oscillators. These oscillators (for ranges 1 - 10) in addition to the stripline oscillator (range 11) cover the entire output frequency range of the instrument on fundamentals. Each oscillator has a working frequency tuning range of approximately $\sqrt{2}:1$ up from its lowest frequency. A Colpitts configuration common source f.e.t. is used with varactor diodes as the tuning elements.

Tuning is performed by applying a positive voltage to the varactor cathode. Frequency modulation is accomplished by applying the audio signal to the varactor anode suitably attenuated by a resistor potential divider so that the varactors are never forward biased.

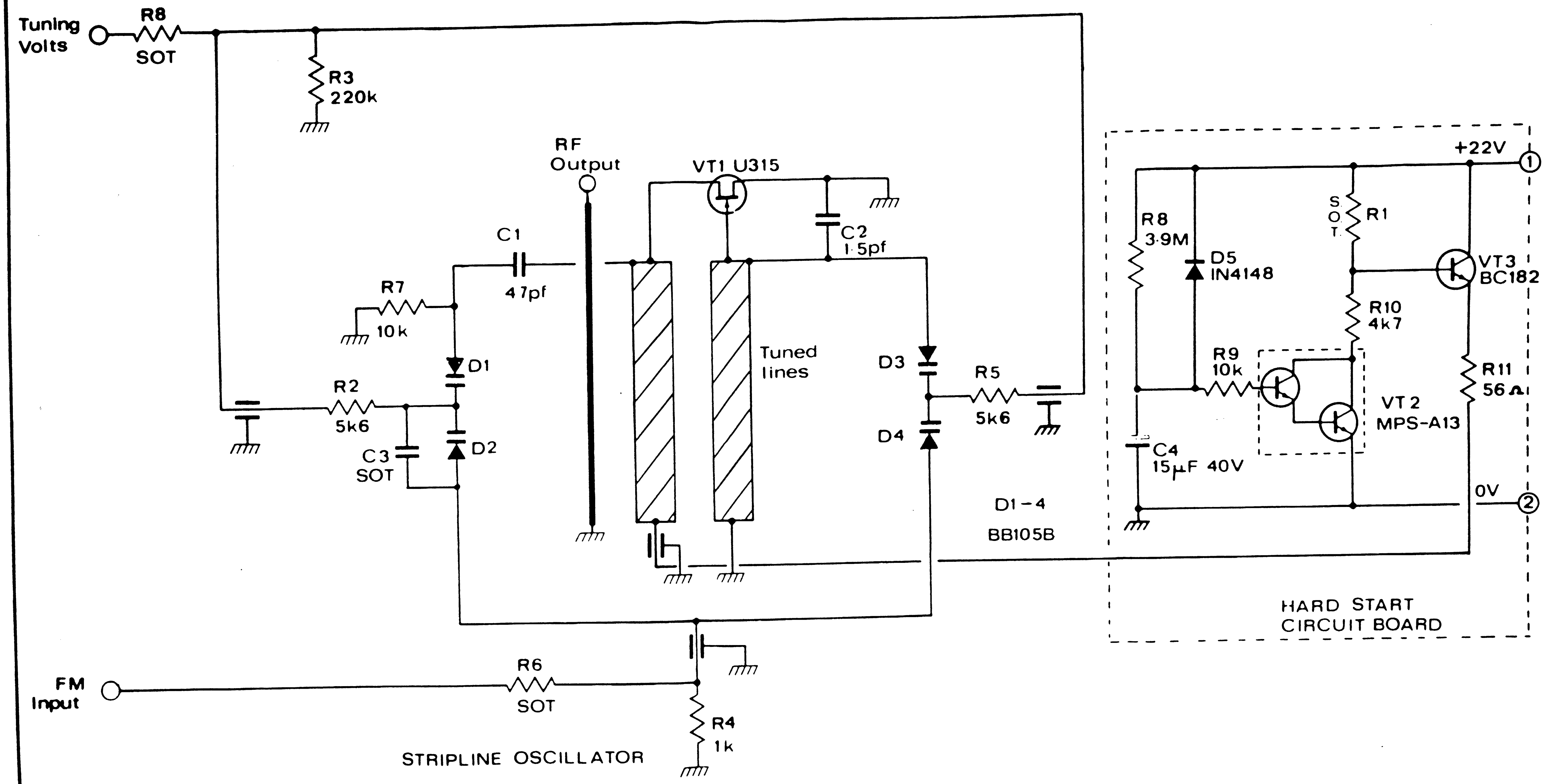
The ranges are selected by turning on the bias supply to the required f.e.t. The r.f. output is taken from each oscillator coil by inductive coupling and the harmonics suppressed by RC filtering. A PIN diode links each r.f. output to the common output track. The PIN diodes are forward biased to route the required oscillator out by the f.e.t. bias supply.

The r.f. output is then fed to the buffer amplifier and prescaler.

DRAWING No. 3SZ0832170

R	8	3 2 7	6	4	5 8 9 10 1 11	
C			1	1 2	4	2 3
VT				1		
MISC		D1,2			D3,4	D5

USED ON



STRIPLINE OSCILLATOR

TRACED			
	D	3.10.78	04964
CHECKED	C	6.4.78	4574
S.D.	B	7.12.77	04409P
DRAWN	ISS	DATE	MOD No
J.N.	A	14.10.77	—

FARNELL INSTRUMENTS LTD. WETHERBY.

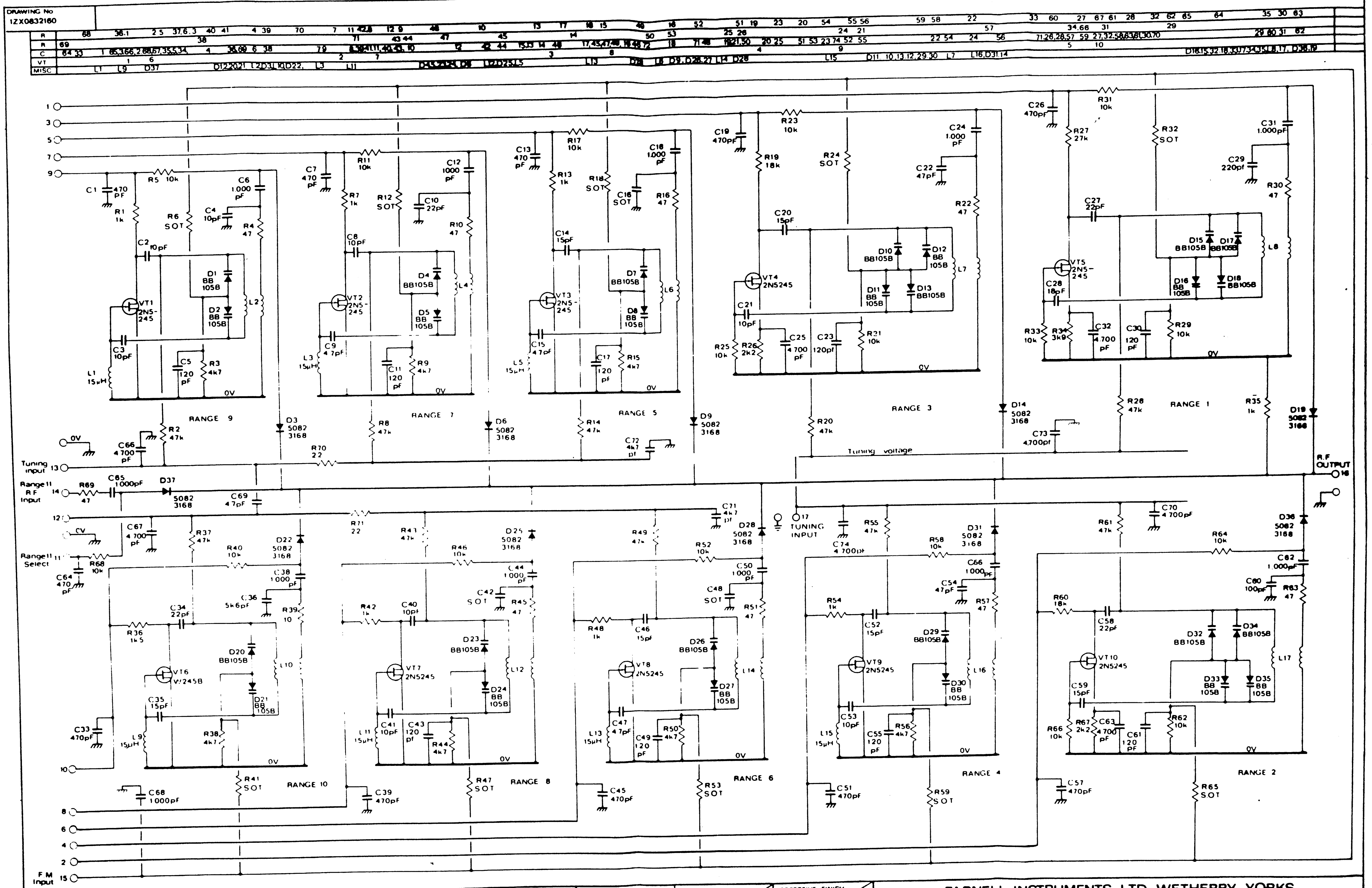
TITLE STRIP LINE OSCILLATOR

SSG520

DRAWING No 3SZ0832170

Section 3 issue 1 11·78

SHEET OF SHEETS



Traced	E	31 July 78	Q4677
	D	30.6.78	Q4745
Checked	C	2.5.78	Q4660
GD	B	6.12.77	Q4609P
Drawn	ISSUE	DATE	MOD No
JN	A	19.10.77	

NOTE
ALL RESISTOR VALUES GIVEN IN OHMS
ALL CAPACITOR VALUES GIVEN IN μF

TOLERANCE
MATERIAL
SCALE
PROTECTIVE FINISH
DIMENSIONS IN MM

FARNELL INSTRUMENTS LTD. WETHERBY. YORKS.

TITLE
VARACTOR OSCILLATOR SSG520
CIRCUIT DIAGRAM *Section 3 issue 1 11·78*

DRAWING No 1ZX0832160
SHEET 1 OF 1 SHEETS

THE FIRST ALC AMPLIFIER AND RANGE DECODER

1. *First ALC amplifier*

The r.f. output from the oscillator circuit board is fed to a two stage r.f. amplifier with an a.l.c. loop. This amplifier provides two important functions.

(i) Isolates the oscillators from the amplitude modulator thus avoiding frequency pulling

(ii) provides an adjustable levelled output for input variations of approximately 20dB range.

The d.c. output of the two Schottky detector diodes is fed to the inverted input of a high gain differential amplifier. The other amplifier input is referenced to a d.c. voltage adjusted by a preset potentiometer thus providing control of the output level. The output of the differential amplifier drives an emitter follower stage to provide current drive for the PIN diode. The loop is closed with a series PIN diode L section r.f. attenuator. Thus as the detected d.c. voltage increases (r.f. level increasing) the d.c. bias for the PIN diode is reduced, increasing the r.f. attenuation and maintaining the output level constant.

The loop response time is such that it will respond quickly to oscillator level changes with f.m. or sweep signals applied and so prevent the occurrence of amplitude pulling with frequency change.

The r.f. signal is fed to the amplitude modulator and prescaler buffer amplifier.

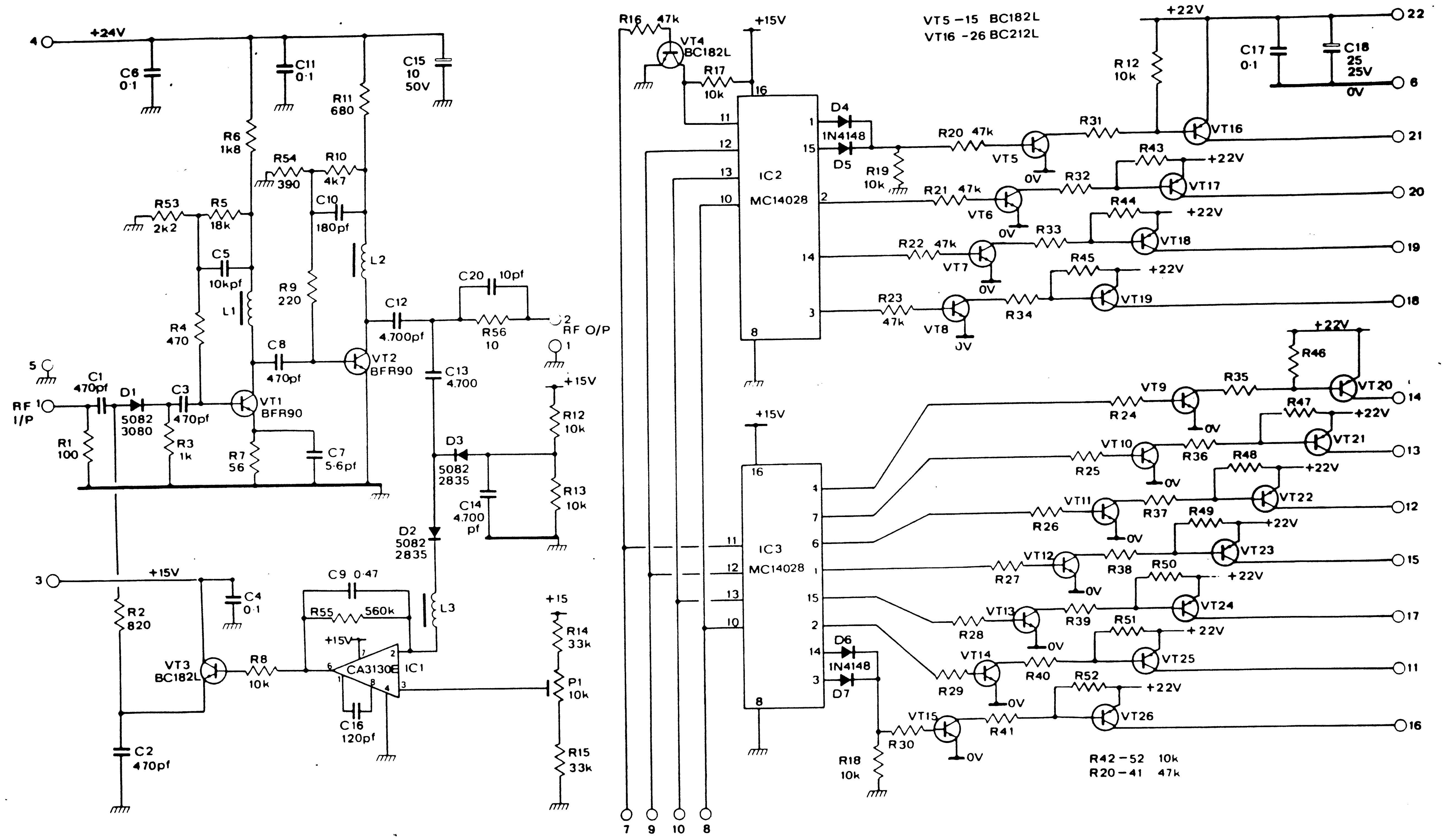
2. *Range decoder*

The range select data enters the r.f. box from the control board as four line binary to keep the number of feedthrough capacitors on the box lid to a minimum. Two b.c.d. to decimal converters wired in parallel are arranged to decode the thirteen binary input codes into one of eleven output lines. Input binary codes 0 and 1 drive range 1 and input binary codes 11 and 12 drive range 11. (The two extra range codes 0 and 12 are used as under and over range information on the range control board).

Each of the eleven output lines separately switches the 22V supply to one of the r.f. oscillators via two drive transistors.

DRAWING No 2ZX0832169

R: 1 2 53 5 6 54 9 10 11 56 12,13 14,15 16 17 18, 19, 22, 21, 20, 41, 34,40 32,45, 31,44, 38,43,50, 36 35 46 | 23,30, 29 28, 27 26, 33,25,39,52,24,51,12,37, 49 48 47
R: 4 7,8 | 17 18
C: 1 2 6 3 54 8 11 7 10 9 16 12 13,15 20,14 | 15,8 7,14,6 13, 5,12 19 11 18, 10,25,17,24,9,16,23,22, 21 20
VT: 1 55 4
MISC: D1 VT3 L1 IC1 L2,D2 L3, D3. P1 IC2, IC3, D4,5,6.



ALL RESISTORS IN OHMS UNLESS OTHERWISE STATED
" CAPACITORS " µf " " "

TRACED		
CHECKED	C	
	B	
DRAWN J N	ISS	DATE	MOD No
	A	14 10 77	

SCALE

FARNELL INSTRUMENTS LTD. WETHERBY

TITLE A.G.C. AMPLIFIER/RANGE DECODER C/D

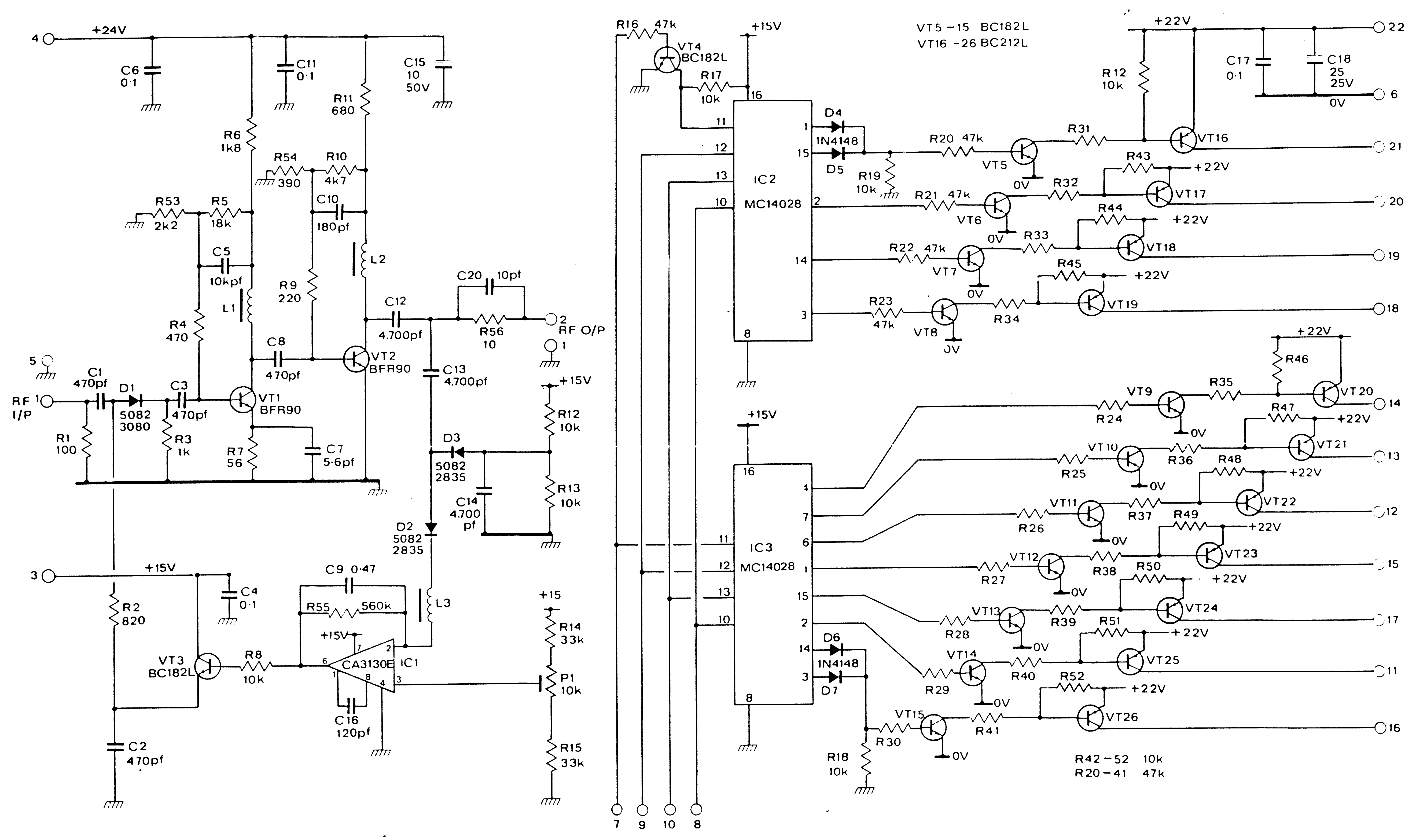
Section 4 issue 1 11·78

DRAWING No 2ZX0832169

SHEET OF SHEETS

DRAWING No
2ZX0832169

R	1 2 53 5 6 54 9 10 11 56 12.13 16 17 18. 19.22. 21.20. 41. 34.40 32.45.31.44.38.43.50. 36 35 46
R	4 7.8 14.15 23.30. 29 28. 27 26.33.25.39.52.24.51.12.37. 49 48 47
C	1 2 6 3 5 4 8 11 7 10 9 16 12 13.15 20.14 17 18
VT	1 55 4 15.8 7.14.6 13. 5.12 19 11 18.10.25.17.24.9.16.23.22. 21 20
MISC	D1 VT3 L1 IC1,L2.D2 ,L3, D3. P1 IC2. IC3. D4.5.6.



ALL RESISTORS IN OHMS UNLESS OTHERWISE STATED
" CAPACITORS " µf " " "

TRACED			
	D	5.3.79	6351
CHECKED	C	4.6.78	4903
	B	7.12.77	Q4409P
DRAWN J N	ISS	DATE	MOD No
	A	14.10.77	

SCALE

FARNELL INSTRUMENTS LTD. WETHERBY

TITLE
A.G.C. AMPLIFIER/RANGE DECODER C/D

DRAWING No
2ZX0832169

THE AMPLITUDE MODULATOR AND ALC OUTPUT AMPLIFIER

1. *Amplitude modulator*

The signal from the 1st a.l.c. amplifier drives the amplitude modulator.

The amplitude modulator comprises a 'T' section r.f. attenuator using PIN diodes, thus enabling the attenuation to be controlled by the d.c. bias current to the diodes.

The series PIN diodes have adjustable d.c. bias to set the insertion loss of the modulator, while the shunt diode has an essentially fixed bias with a very fine adjustment for setting the modulation distortion. Amplitude modulation is achieved by superimposing an audio signal on to the static d.c. bias of the PIN diodes. On the positive going cycle of the audio modulating signal the bias current to the series PIN diodes is increased, but reduced to the shunt diode (vice versa for the negative cycle).

PIN diodes have a slightly non-linear current versus r.f. resistance characteristic. By using a 'T' attenuator with the same static bias current as the series and shunt diodes, the modulation signal, when applied to the shunt diode, tends to cancel out the non-linearity of the series diodes. The modulation distortion potentiometer provides slight adjustment of the shunt diode current so that the shunt-series diode laws may be matched.

The r.f. is then routed to the output amplifier via a circuit board link.

2. A.L.C. *output amplifier*

The r.f. output from the modulator is fed to a three stage wideband r.f. amplifier with an a.l.c. loop. Three stages of gain are required to make up the amplitude modulator insertion loss and enable a maximum r.f. output capability of at least +6dBm. This ensures maximum modulation depth capability with minimal additional distortion.

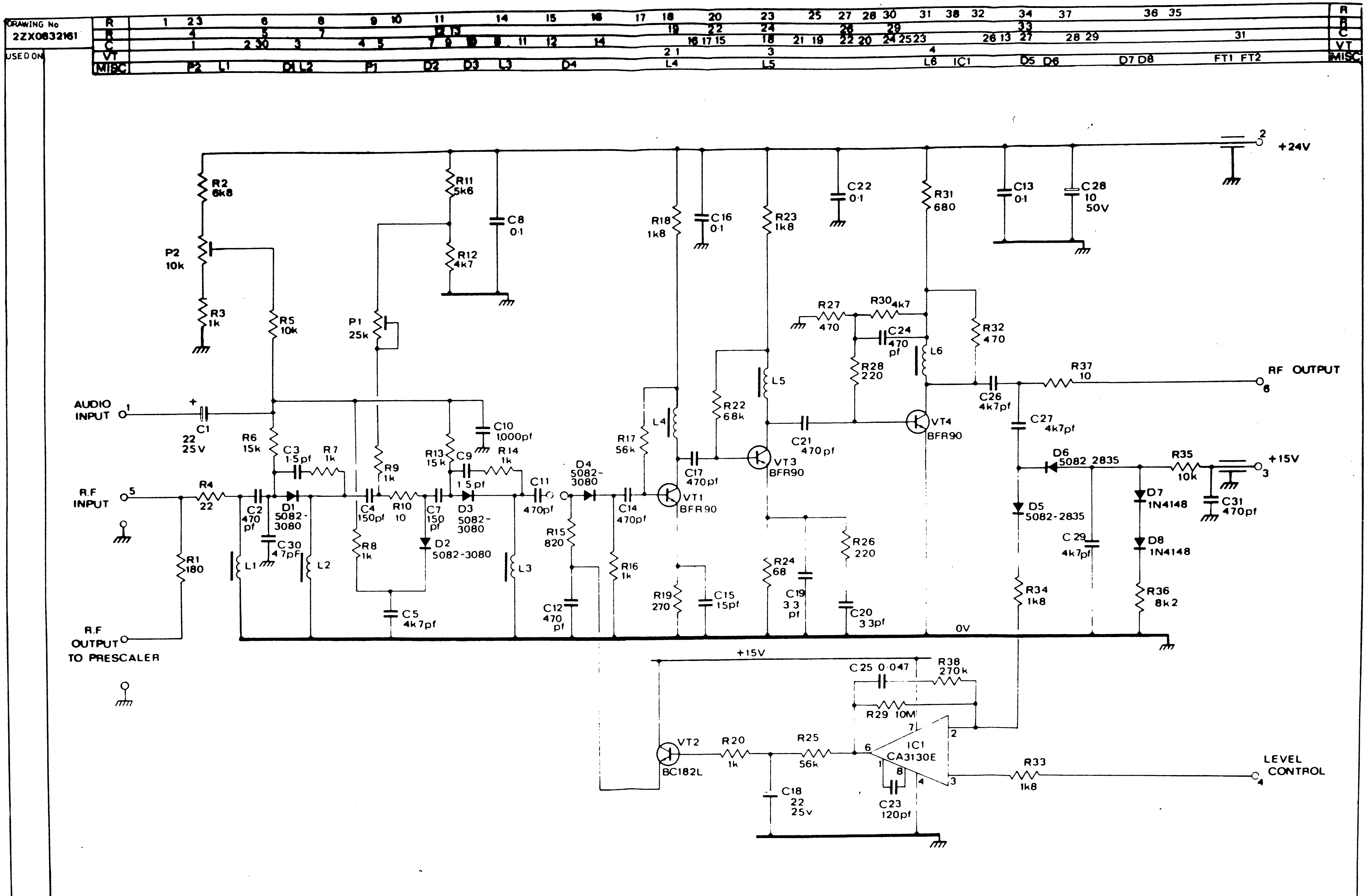
The d.c. output from the Schottky detector diodes is fed to the inverting input of a high gain differential amplifier. The non-inverting input is referenced to a d.c. level. This d.c. level is obtained from the control board and is varied by the r.f. level control and 1dB step attenuator switch. The output of the differential amplifier drives an emitter follower stage to provide current drive for the PIN diode.

The loop is closed with a series PIN diode 'L' section r.f. attenuator. Thus as the detected d.c. voltage increases (r.f. level increasing) the d.c. bias for the PIN diode is reduced and the r.f. level attenuated more.

The detector stage has Schottky diodes in the d.c. bias line to compensate for temperature variations. This ensures the r.f. output amplitude does not change appreciably with temperature.

The a.l.c. loop time constant must be large compared to 50mS (20Hz) so that the loop does not remove or distort the amplitude modulation at 20Hz modulation frequency. A low pass filter in the output of the differential amplifier ensures this.

After the output amplifier the r.f. signal is passed to the 10dB step attenuator.



TRACED	E	20·6·78	4746	F	31 July 78	4877
	D	26·5·78	4493	G	4 Aug 78	4905
CHECKED	C	10·4·78		H	6 Oct 78	4965
S D	B	7·2·77	04409P	I	8-11-79	5067
DRAWN	ISS	DATE	MOD No			
J N	A	10 10 77				

All Resistor values in ohms unless otherwise stated
" Capacitor " " µf " " "

TOLERANCES
MATERIAL
SCALE
PROTECTIVE FINISH
DIMENSIONS IN MM
NOTE REMOVE ALL BURRS AND SHARP EDGES

FARNELL INSTRUMENTS LTD WETHERBY

TITLE CIRCUIT DIAGRAM AMPLITUDE MODULATOR AND O/P AMP SSG520

Section 5 issue 1 11·78

DRAWING No 2ZX0832161

SHEET 1 OF 1 SHEETS

THE OUTPUT ATTENUATOR

The output amplifier is fed to the coarse step attenuator. This comprises a 10dB, 20dB and two 40dB sections switched in with r.f. relays thus giving a range of -10dB to 110dB. The attenuators are Pi section resistor networks with a characteristic impedance of 50Ω. Small impedance matching capacitors are required progressively along the attenuator to compensate for the slight inductance of the relay leads.

The relay cans are retained in the attenuator frame by screw rings enabling replacement in the event of damage. The screw thread also provides good r.f. sealing.

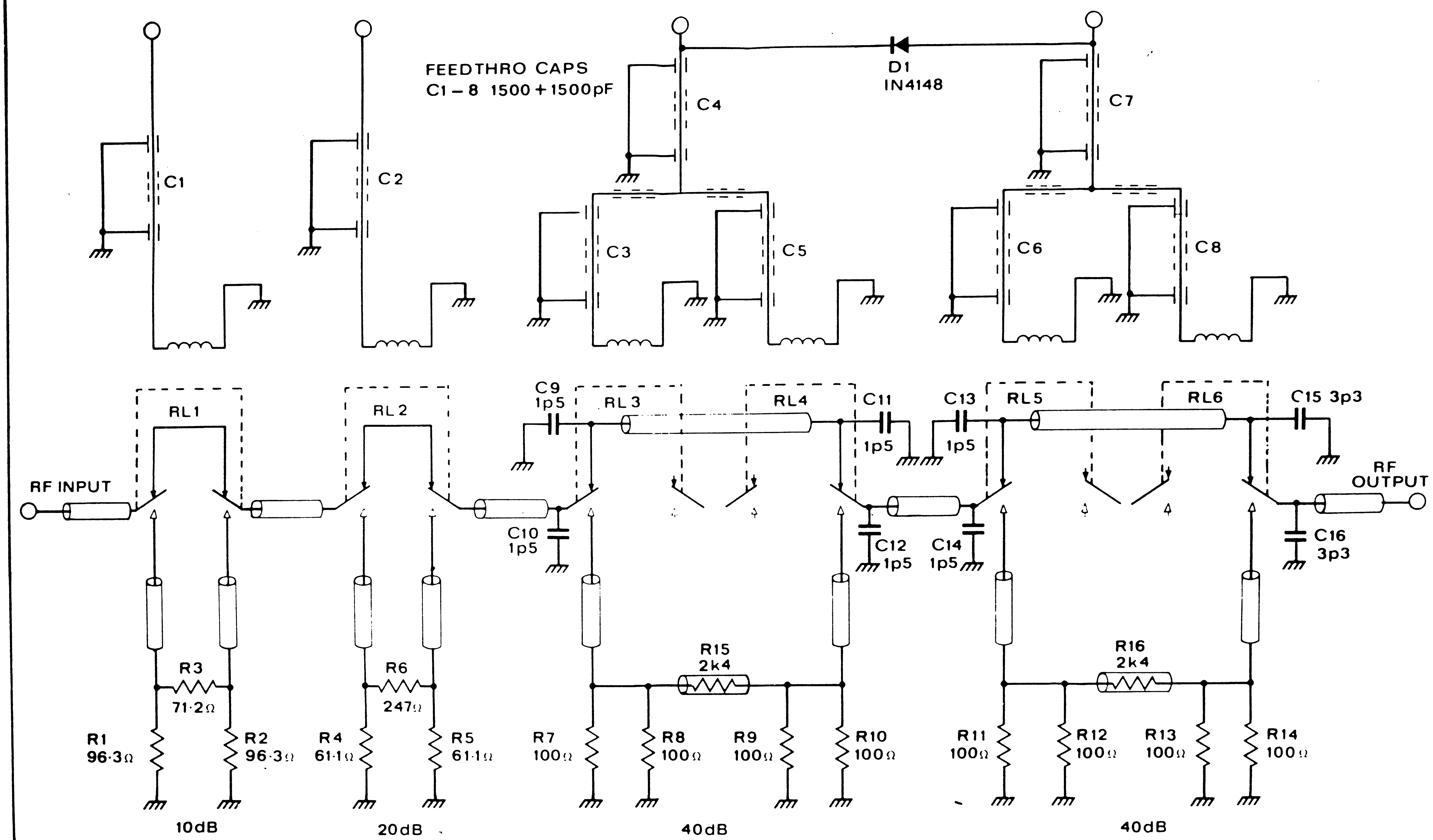
Single Pi section feedthrough capacitors are used on the supply rail to the 10 and 20dB sections but two stages of feed-through capacitors are necessary for r.f. screening on the 40dB section. The 40dB sections also have copper foil soldered over the attenuator box to prevent cross-talk along the attenuator length.

Two relays are employed for each 40dB section with only one half of each relay being used. This eliminates r.f. cross-talk between relay contacts inside the relay can.

Attenuator sections are connected by lengths of 40Ω solid coaxial tube. Input and output coax connections are in the same material to keep r.f. radiation down.

The attenuator output is connected to the instrument r.f. output socket.

DRAWING NO.
3ZX0832171



TRACED						
CHECKED *GJW*						
DRAWN *A.M.*	ISS. A	DATE 3.4.78	MOD. NO.			

USED ON
832

NOTES

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

TITLE
10dB STEP ATTENUATOR
SSG 520 *Section 6 issue 1 11-78*

DRAWING NO.
3ZX0832171

SHEET 1 OF 1 SHEETS

THE PRESCALER AND PRESCALER BUFFER AMPLIFIER

1. *Buffer amplifier*

The r.f. output from the first a.l.c. amplifier is fed to a two stage r.f. amplifier with a.l.c. loop. This amplifier provides two important functions.

(i) Isolates the r.f. chain from the prescaler, reducing feedback of logic spikes,

(ii) provides an adjustable levelled r.f. output. This controllable level output is essential to ensure that the e.c.l. prescaler logic following is correctly toggled.

The d.c. output of the Schottky detector diodes is fed to the inverting input of a high gain differential amplifier. The non-inverting input is referenced to a d.c. voltage (adjusted by a preset potentiometer) thus providing control of the output level. The output of the differential amplifier drives an emitter follower stage to provide current drive for the PIN diode.

The loop is closed by a series PIN diode 'L' section r.f. attenuator.

The buffer amplifier output is fed to the prescaler circuit via a circuit board link.

2. *Prescaler*

This is a direct counting, two decade, asynchronously set type of prescaler. It works by removing a preset number of pulses from the synthesizer programmable divider chain, the preset number being set by the thumbwheels. These pulses are removed sometime during the clock period of the divider chain. In the following description, figures shown thus (1) refer to the timing diagram sequence.

a) Assume the initial conditions of both divide 10/11 counters IC2 and 7 being in the ÷10 mode, that is one or more of the E inputs being hi.

b) The LOAD pulse is a lo going hi (from the divider chain circuitry). On the rising edge (1) the Q1 output of IC6 goes hi (2) and is latched there independent of further load pulse transitions. Assume that this load pulse is asynchronous with any pulses on the prescaler board.

c) The output is the DATA input of another flip flop. On the next clock output rising edge (3), IC7 pin 7, the DATA is transferred to the Q2 output of IC6 (4).

d) This Q2 output holds the E5 input of IC7 hi so that it still divides by 10.

e) The Q2 output of IC6 loads the divide by a counter, IC8, with the thumb-wheel information, in this case the counter is loaded to 1 so the max/min output of this counter goes lo (6). This enables the counter and takes the E4 input of IC2 lo (but the E5 input is still hi) but the counter does not count because the load pulse is overriding any clock pulses. The $\overline{Q2}$ output of IC6 also resets the Q1 output of IC6 to lo (7) ready for the next LOAD pulse when the sequence would start again.

f) The Q2 output of IC6 is also the DATA input of IC5. On the next rising edge of the Q4 output of IC2 the Q2 output of IC5 goes hi (8). This holds the E1 input of IC2 hi and also takes the output of the 5 input NOR gate lo (10) which is the S2 input of IC3 and the E2 input of IC2.

g) The Q2 output of IC5 goes lo (9) which is the S1 input of IC3.

h) The next rising edge of the Q4 output of IC2 loads the ÷n counter, IC3, with the thumbwheel information, in this case the counter is loaded to 2, so the decoded outputs feeding into the 5 input NOR gate change to the loaded-in information.

i) When the clock output next rises (11) the Q2 output of IC6 changes to lo (12) because the data changed at note (e) to lo, this removes the hi on the E5 input of IC7, so that IC7 next time round would divide by 11. The data input of IC5 is now lo.

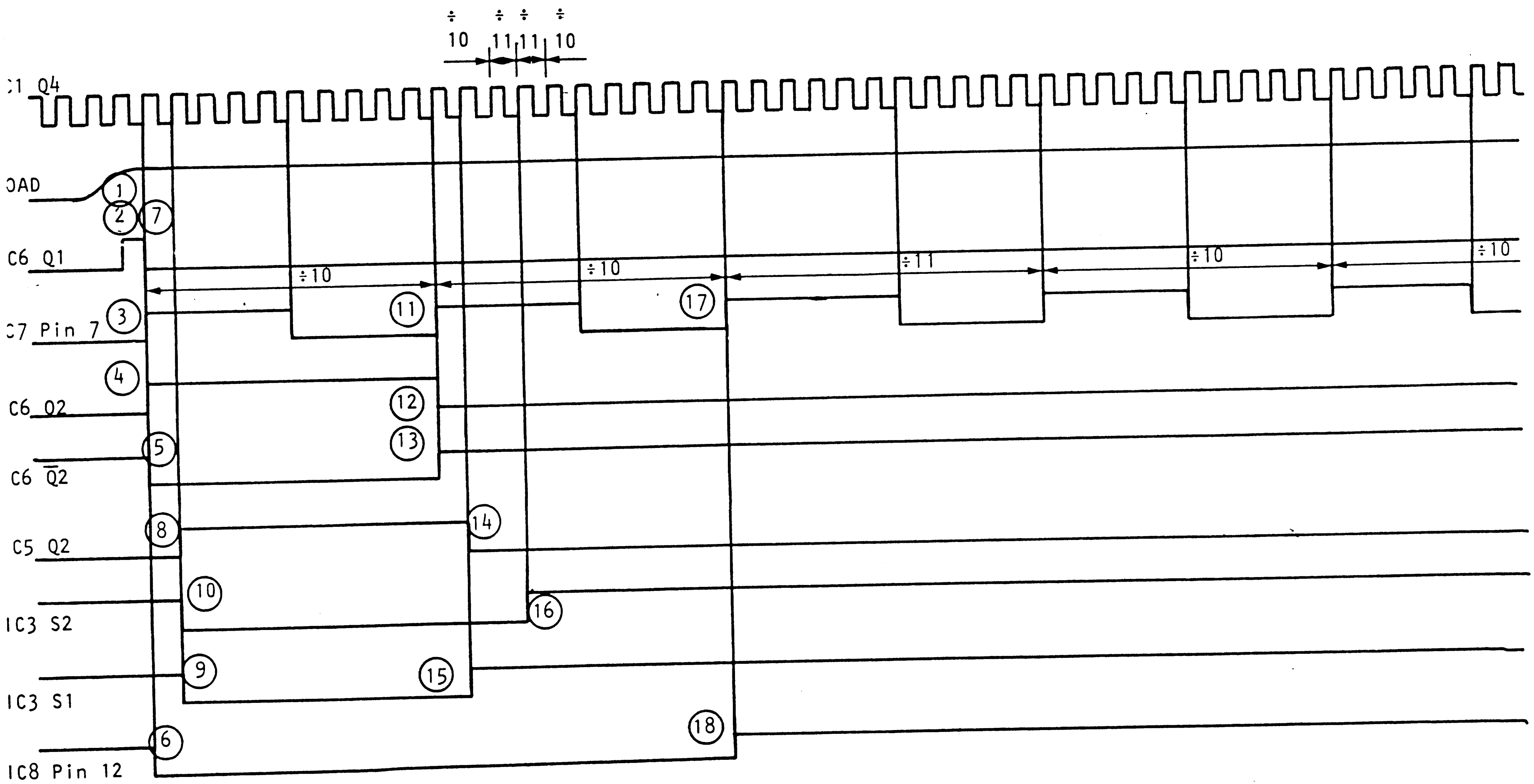
Also the load pulse of IC8 is removed (13) and IC8 can now count down on subsequent clock pulses.

j) The next rising edge of the Q4 output of IC2 changes the Q2 output of IC5 to lo (14) and so the E1 input of IC2 is also lo, so IC2 next time round would divide by 11.

k) The $\overline{Q2}$ output of IC5 and thus the S1 input of IC3 goes hi (15) thus IC3 is enabled to count down.

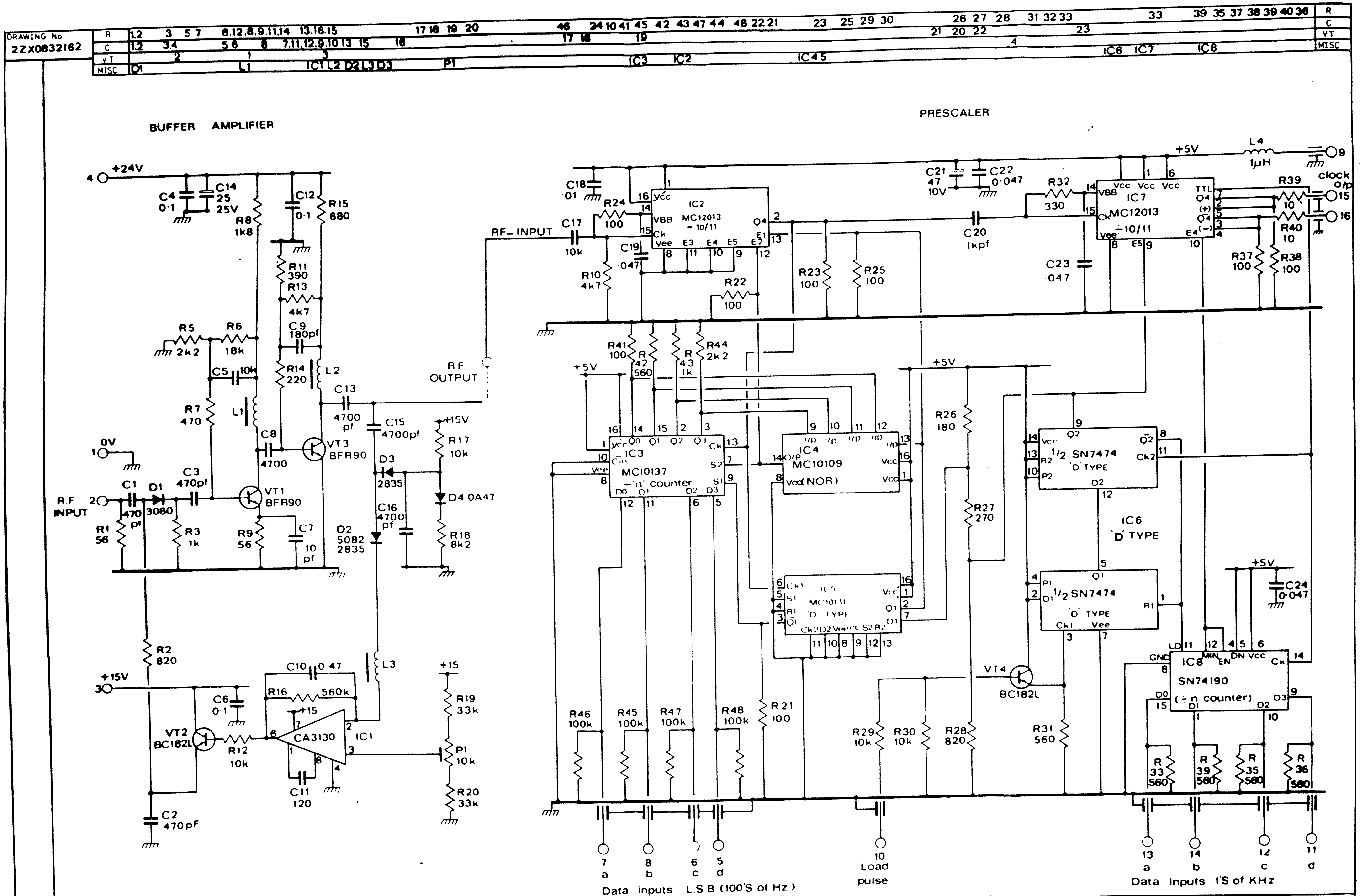
l) The next two rising edges of the Q4 output of IC2 decrement the counter IC3 to zero so that the output of the 5 input NOR gate, the S2 input of IC3 and the E2 input of IC2 goes hi (16) . This has the effect of inhibiting IC3 so the circuit remains latched in this position until another LOAD pulse arrives, and telling IC2 to divide by 10 after the completion of the last ÷ by 11 (having divided by 11 once previously).

m) When the clock output next rises (17) IC8 decrements to zero so that its max/min goes hi (18) . This disables the counter and takes the E4 input of IC2 hi so that after completing the ÷ 11 count IC2 will continue on to divide by 10 and the whole system remains static in this mode until the next LOAD pulse.



PRESCALER TIMING DIAGRAM

LSB (100Hz) loaded to 2
Next SB (kHz) loaded to 1



TRACED	E	26.5.78		F	31Jun '78	
	D	19.4.78				
CHECKED	C	20.3.78	Q4421			
	B	7.12.77	4409P			
DRAWN	ISS	DATE	MOD No			
JN	A	8/11/77				

Resistor values in ohms
Capacitors values in µF unless otherwise stated

SCALE

FARNELL INSTRUMENTS LTD.WETHERBY

TITLE SSG520
PRESCALER AND BUFFER AMP.

DRAWING No 2ZX0832162

Section 7 issue 1 11·78

SHEET 1 of 1 SHEETS

THE R.F. BOX EXTERNAL AND INTERNAL WIRING

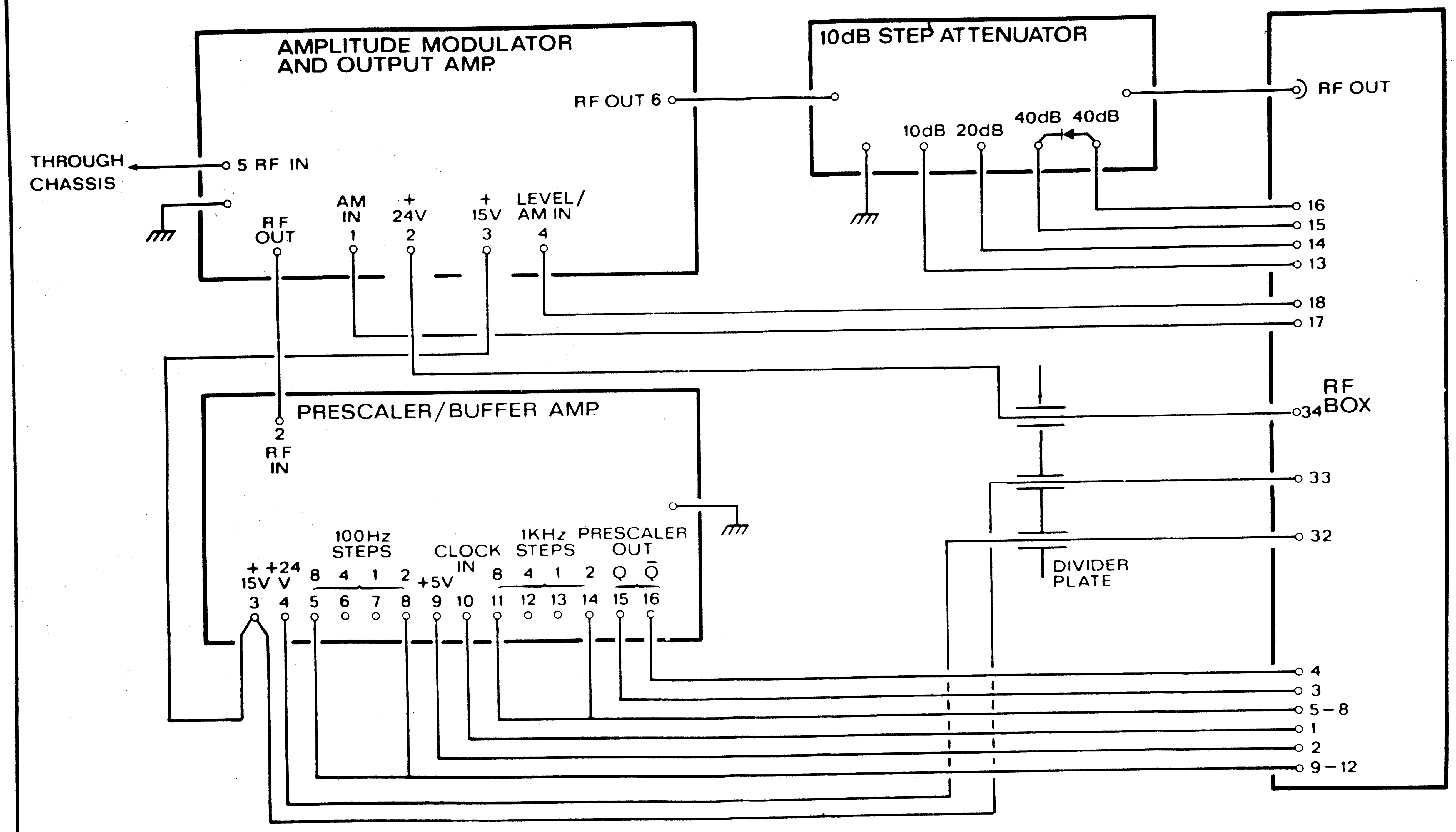
The r.f. box is fitted with capacitive feedthroughs on all connections except the main coaxial r.f. output. These feedthroughs are arranged in a double filtering system with two separate sets of gaskets to ensure maximum r.f. screening.

All instrument earth wires are taken to tags on the r.f. box and this is the only chassis member designed to carry current.

Inside the r.f. box the high frequency earth continuity is of paramount importance so all r.f. boards are directly earthed to the chassis with coaxial leads linking the circuit functions. The range decode/select logic section is not earthed in this way as it carries no r.f. but has a separate earth wire taken back to the common earth tag in the stripline oscillator.

The majority of wiring for the circuits on one side of the r.f. box is taken to the feedthrough capacitors on the same side. The few connections that do pass between r.f. box upper and lower sides are taken via capacitive feedthroughs in the centre plate, or via coaxial cable.

DRAWING NO.
3ZV0832279



TRACED					
CHECKED					
	B	18 Aug 78	4419		
DRAWN	ISS	DATE	MOD NO		
	A	27.4.78			

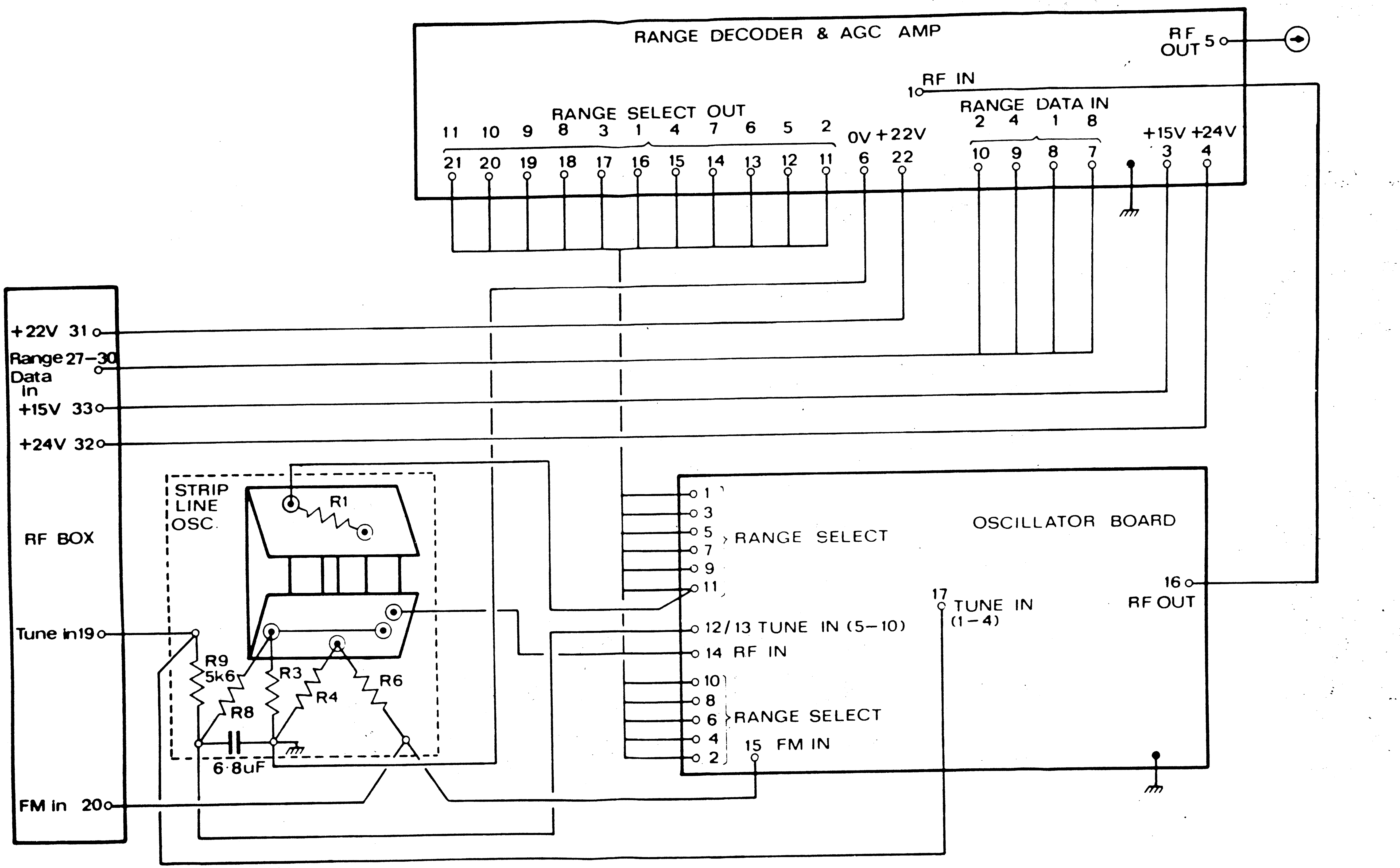
USED ON
832

FARNELL INSTRUMENTS LTD. WETHERBY.

TITLE
SSG RF BOX (UPPER SECTION)
WIRING

DRAWING NO.
3ZV0832279
Section 8 issue 1 11.78

DRAWING No. 3ZV0832270



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FARNELL INSTRUMENTS LTD. WETHERBY.

TITLE: RF BOX (LOWER SECTION) WIRING SSG520

DRAWING No 3ZV0832270

Section 8 issue 1 11·78

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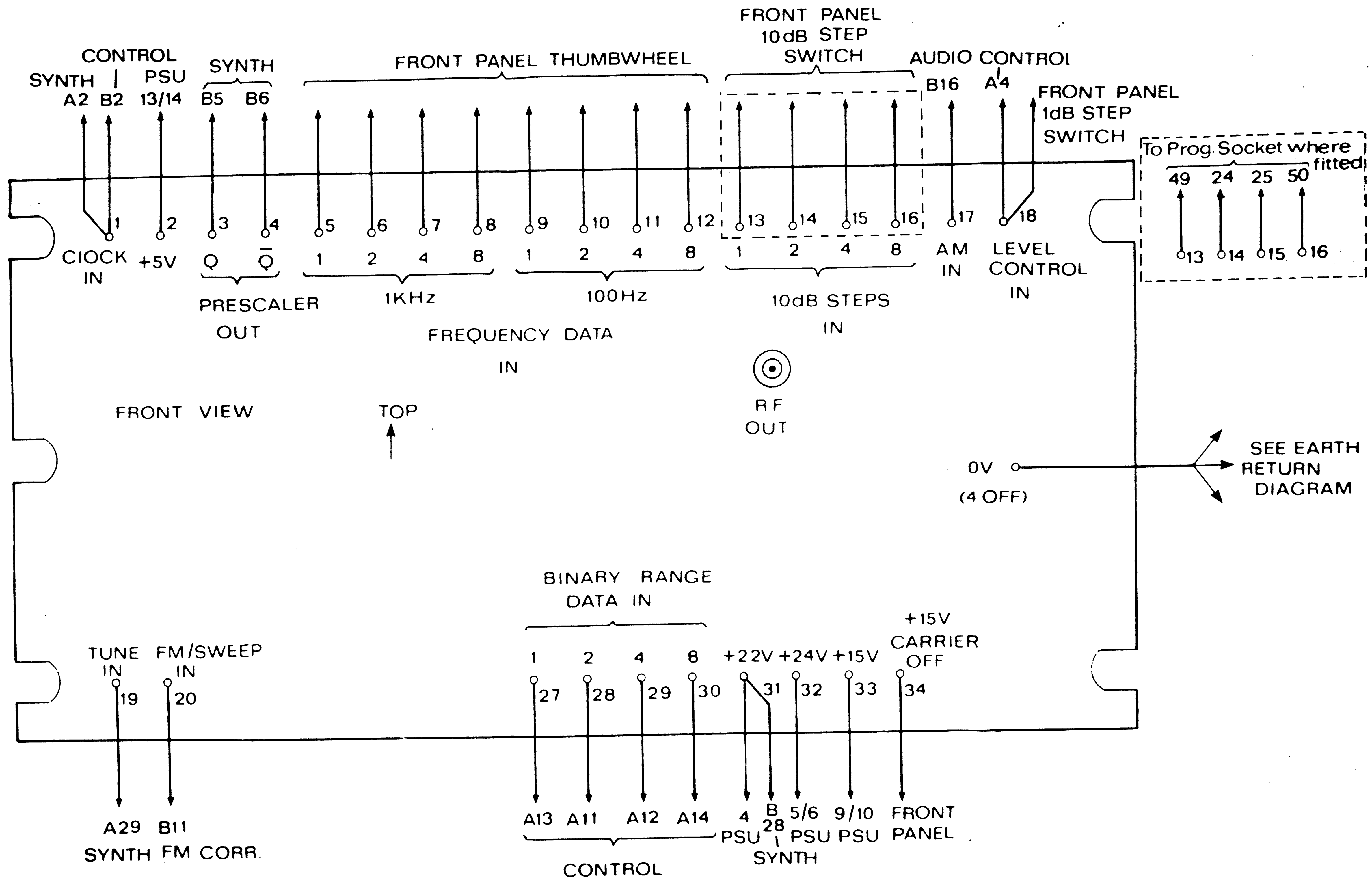
3ZV0832274



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NOTE

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TITLE
RF BOX WIRING
SSG520

DRAWING No
3ZV0832274
Section 8 issue 1 11·78

The monostable

Because the different range change points are applied to the comparator's 'B' inputs via diodes which are passively pulled down it is possible for some 'B' information to overlap thereby momentarily applying a much higher 'B' number than is actually required. This causes a spike on the A<B output for the duration of the overlap when in fact A is supposed to be greater than B. The falling edge of this spike, or spikes, will trigger the monostable and cause a series of wrong range selections. To eliminate this problem the trigger input of the monostable is connected to the A<B output via a 100K resistor. Normally the input capacitor, C2, is charged up by the A<B output being high so that when it goes low both sides of the capacitor go low until the capacitor charges via R33. When the A<B line goes high again the capacitor discharges via R34 and an internal diode on the gate input which is not shown on the diagram. If the A<B line does not stay high long enough to discharge the capacitor, as in the case of a spike, then the falling edge cannot trigger the monostable, so R34 is made large enough to stop a spike discharging C2 and small enough compared to R33 not to pot down the amplitude of the trigger pulse.

2. *Output level*

This circuit provides the d.c. reference for the r.f. output amplifier a.l.c. It further modifies this level in logarithmic steps to provide the 1dB output level steps. A summing amplifier has two d.c. sources, one of which calibrates the output level, the other is variable allowing a vernier control of level. The amplifier output before passing to the 1dB step switch, drives the output level meter. Diode temperature compensation is provided for the 1dB step attenuator.

The reference line also has an input from the audio board which compensates the output level as amplitude modulation is applied thus maintaining constant average r.f. output level.

As the counter is clocked, the lower limits of the oscillator ranges are applied one after another to the comparators. The A<B output of the comparators remains high as long as the 'A' input is lower than or equal to the 'B' input. (In our case the A input is the thumbwheel switch information and the B input is the oscillator lower range points). As soon as a lower range limit less than the thumbwheel switch setting is applied to the 'B' input the A<B output goes low. This falling edge is used to trigger a monostable,the output of which is connected to clock the 4 bit latch, IC3. The outputs of the counter are clocked through the latch at this time to operate the appropriate oscillator range. Since a clock pulse only occurs every time the A<B output of the comparator goes low,the latch only lets through the one range immediately below the thumbwheel setting.

The counter is being continually clocked round so that if the thumbwheel information is changed the trigger occurs at the appropriate range.

NOTE: Range 13 is applied to the 'B' input of the hundreds of MHz comparator by taking the 'd' and 'c' input high. This is a number which is far higher than the thumbwheel switches can go. This ensures that the A<B output always goes high at some point so that the falling edge can trigger the monostable.

Out of range indication

When frequencies above 520MHz are selected range 12 is the one decoded. Gates consisting of IC6b and part of IC5 decode range 12 and change the binary information applied to the outputs to range 11 at the same time activating the 'overrange output and the 'out of range' output. Similarly, when the frequencies below MHz are selected range 0 is decoded. IC6a decodes this and changes the output information to range 1, at the same time activating the 'under range' and 'out of range' outputs.

Manual operation

When the Auto/Man. switch (provided for test purposes) is set to Man. the preset enable of the counter forces the counter outputs to be the same as the preset inputs which are selected by the data switches. The monostable output is forced low, by the diode D53 forcing the inverting buffer input high, so the latch outputs follow its data inputs which in turn follow the preset inputs of the counter. The counter clock has no effect at this time because the preset enable overrides the clock.

THE RANGE CONTROL AND OUTPUT LEVEL BOARD

1. *Range control*

The control board sends information to energise the appropriate r.f. oscillator for any selected frequency within the coverage 10 to 520MHz as selected either by the thumbwheel switches or an external programme (if fitted). The range information is coded in four line binary and fed to the r.f. box where it is decoded into individual lines to drive the selected oscillator.

The thumbwheel switch information of the megahertz, tens and hundreds of megahertz digits is taken in b.c.d. form to the 'A' inputs of three digital comparators IC7, IC8 and IC9 connected in series. The lower range limit of each oscillator is then applied successively to the 'B' inputs, again in b.c.d. form. A binary down counter, IC4, is clocked continuously by the 100Hz clock pulse. The counter's a, b, c and d outputs go to the data inputs of a four bit data latch, IC3, which transfers data from its inputs to its Q outputs when its clock input is low. (Its clock input is normally high). The counter's outputs also go to IC1 and IC2 which together decode the binary information into hexadecimal (sixteen lines).

NOTE: Qo of IC2 = 0, Q1 = 1, Q2 = 2 ..... Q7 = 7 then Qo of IC1 = 8
Q1 of IC1 = 9, Q2 = 10, Q3 = 11 .... Q7 = 15

As the counter counts down from 15 to 0 each of the sixteen decoded lines in turn goes high. Some of these lines are connected to the 'B' inputs of the digital comparators via diodes so that the data inputs have the lower limit of the oscillator one range higher than the counter applied to them in b.c.d. form. For example:-

If the counter is on range four its d, c, b and a outputs are 0, 1, 0, 0 respectively and the Q4 output of IC2 is high. This output (Q4) has diodes connected to the 'c' input of the tens of MHz comparator, IC8 and the 'c' and 'a' inputs of the MHz comparator, IC9. The number applied to the comparator's 'B' inputs therefore is 45 which is the lower limit of range 5.

The next 100Hz clock pulse decrements the counter to range 3 where its outputs are 0, 0, 1, 1, which energises the Q3 output of IC2 which applies 33 (range 4 lower limit) to the comparator by pulling the 'b' and 'a' inputs of both the MHz and tens of MHz comparator high.

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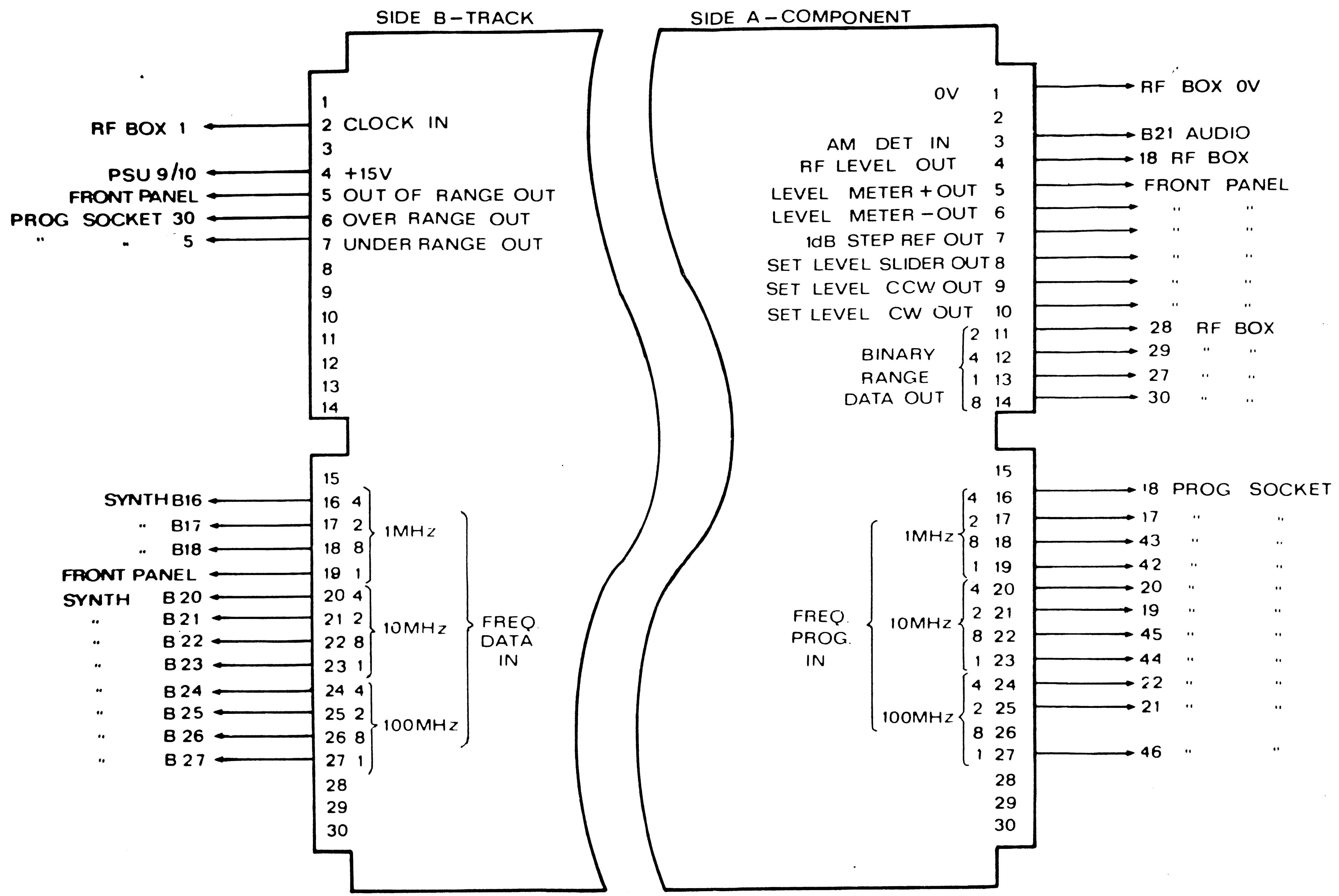

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TITLE
CONTROL BOARD WIRING
SSG520

DRAWING No
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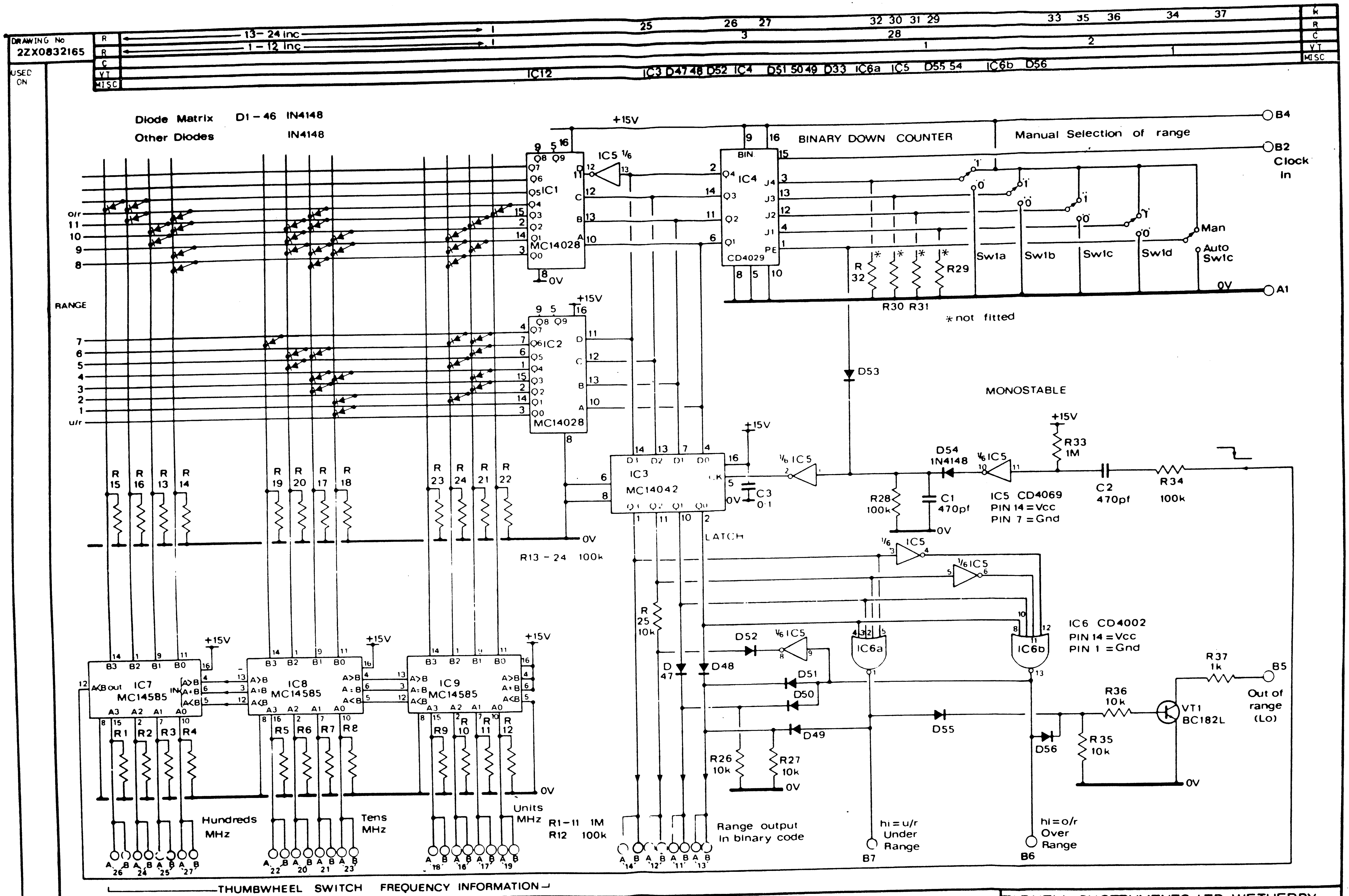
Section 9 issue 1 11.78



FARNELL INSTRUMENTS LTD. WETHERBY

TITLE: CONTROL BOARD SSG520

DRAWING No 2ZX0832165

SHEET 1 OF 2 SHEETS

Section 9 issue 1 11·78

Resistors in ohms
Capacitors in µF unless otherwise stated
OB5 Refers to the circuit board edge connector side A or side B and number

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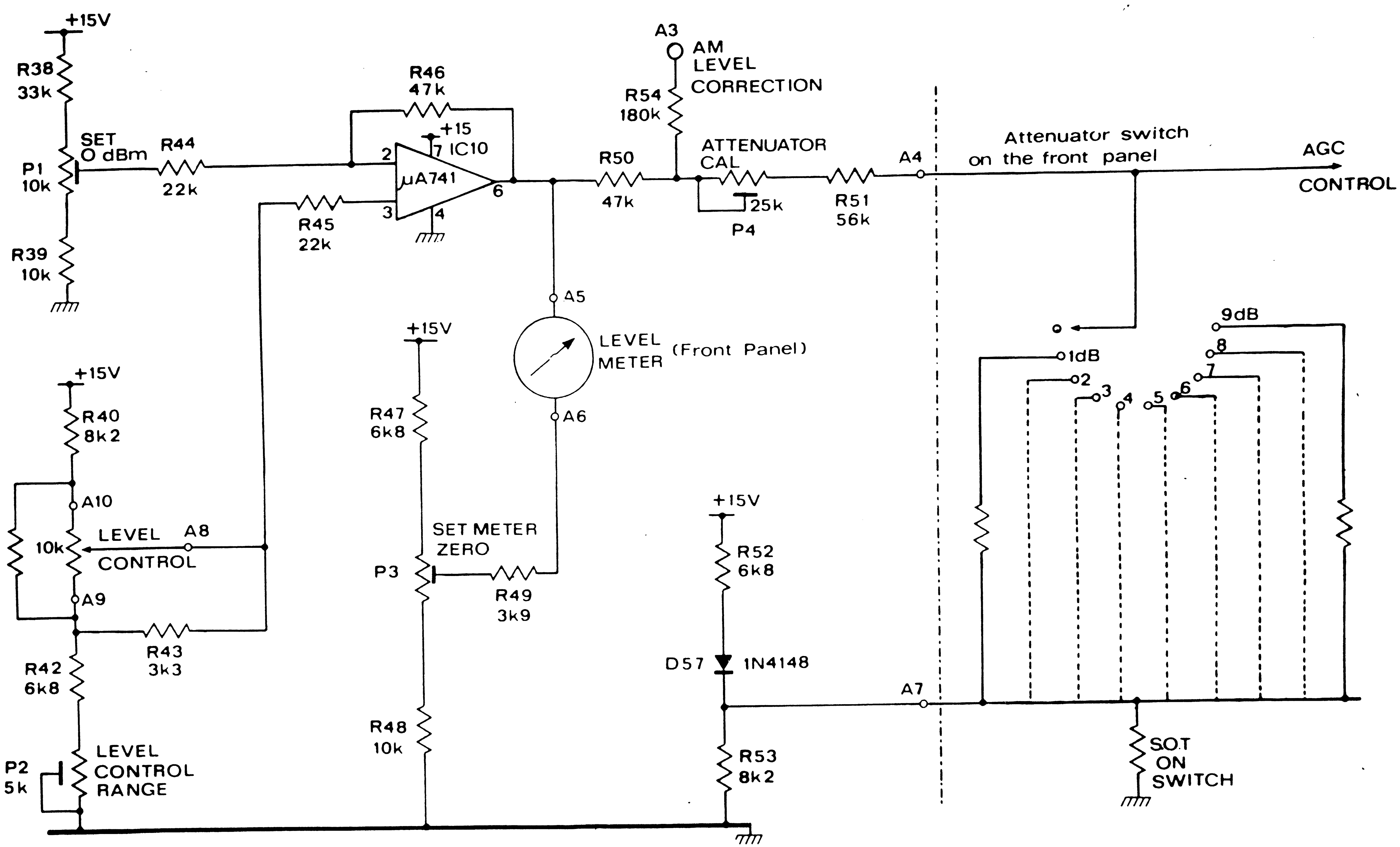
DRAWING No. 3ZX0832165		
	R	41,38,39,40,42,43,44 · 45 · 46,47,48,49, · 50 · 54 · 52,53 · 51
	C	
	VT	
	Misc	P1,2 · P3 IC10 · D57

USED ON

R.F OUTPUT LEVEL CONTROL



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FARNELL INSTRUMENTS LTD WETHERBY

TITLE CONTROL BOARD
SSG520

Section 9 issue 1 11-78

DRAWING No 3ZX0832165

SHEET 2 OF 2 SHEETS

THE SYNTHESIZER BOARD

The purpose of the synthesizer is to provide a d.c. voltage of an amplitude suitable to drive the voltage controlled varactor oscillators to the frequency set up on the thumbwheel switches (provided this is within the oscillator range). It does this by monitoring a sub multiple (in this case 1/100th) of the oscillator frequency and by comparing it to a crystal reference frequency it uses any difference between the two to correct for frequency/ phase errors. The synthesizer can be divided into four sections: Programmable divider, reference divider, frequency/ phase detector and integrator.

1. THE PROGRAMMABLE DIVIDER

This is a chain of five programmable b.c.d. down counters. A programmable counter is one where its outputs can be set to the same states as its programme inputs by application of a pulse to its 'load' input. If the programme inputs of a counter are set to 5 (coded in b.c.d.) and a load pulse is applied, the counter outputs will go to 5. If the load pulse is removed and the counter is clocked down, the outputs will go from 5 to 4, 3, 2, 1, 0, 9, 8, 7 etc. When a number of counters are connected in series the succeeding one is clocked once every time the preceding one goes from 0 to 9.

If three counters are connected in series and loaded together to 5, 3 and 2, where the least significant one is 5 and the most significant one is 2, then the first counter will count from 5 to 4, then 3, 2, 1, 0 and 9 and will continue dividing. The second counter will go from 3 to 2 when the first one has reached the 0 to 9 transition for the first time, from 2 to 1 on the second time around, from 1 to 0 the third time around and from 0 to 9 the next time around when it will also clock the third counter from 2 to 1 etc.

In this example, to count the most significant bit (m.s.b.) counter to zero took 136 pulses made up as follows:-

6 to take the 1st counter to 9 which took the second counter to 2
10 more to " " " " " 9 again " " " " " 1
10 " " " " " " " 9 " " " " " " 0
10 " " " " " " " 9 " " " " " " 9*

*This took the m.s.b. counter to 1 but the others are at 99. To count the m.s.b. counter to 0 means that the others have to go to 99 again which is a total of 100 more pulses.

The total number of pulses to count the m.s.b. counter to zero

= 6 + 10 + 10 + 10 + 100

= 136 pulses.

The other counters at this time are at 99, so to count them to zero takes a further 99 pulses. The total number of pulses required to count all of the counters to zero therefore is 136 pulses + 99 pulses = 235 pulses.

The outputs of the counters are detected for all of them being at zero and this information is used to re-load them. A load pulse then occurs every 235 input pulses. The load pulse is 1/235th of the input frequency, conversely the input frequency is the number set up on the preset inputs (the division ratio) times the load pulse frequency.

In a synthesizer the circuit is designed so that the input frequency is adjusted so that the load pulse frequency is the same as a reference frequency, hence the input frequency = the divider chain division ratio x ref. frequency.

The reference frequency in the SSG520 is chosen as 100Hz and there are five dividers the preset inputs of which are connected to the first five significant thumbwheel switches.

The maximum frequency of the synthesizer input is just in excess of 5MHz (when the thumbwheels are set to 5XXXX which means 5XXXX x 100Hz = 5.XXXXMHz). Because the synthesizer input frequency is 1/100th the oscillator frequency is 5XX.XXMHz and the resolution is 10kHz.

Prescaling (*See prescaler section*)

The division of the oscillator frequency by 100 is known as prescaling and is done because programmable counters tend to be fairly slow devices and cannot work at the high oscillator frequencies encountered in the SSG520. On the other hand ÷ by 10 or 11 counters as used in the prescaler are capable of operating at frequencies up to 550MHz. The straight division by 100 in a prescaler results in a loss of resolution (to maintain higher resolution requires lower reference frequencies which means longer settling times). The prescaler in the SSG520 is uniquely designed to divide by other than a straight 100 and so achieves another two digits of resolution i.e. 1kHz and 100Hz.

Look-ahead

To detect the zero of the counters the 'carry out' terminals of all but the first counter are taken to IC10, a NOR gate. The a, b, c, d outputs of the first counter IC13 are taken via part of IC10 and part of IC12 to the data input of ½IC11, a 'd-type' flip flop, to decode not zero but count 2. This is known as look-ahead and is used to permit faster loading and operation of the counters.

In a non look-ahead system a counter has to count down to zero, have the zero detected, feed the load pulse to the load inputs and remove the load pulse prior to the next clock pulse. The time taken to do all this, observing minimum set-up and release times, must be less than the period of the fastest clock pulse. For the SSG520 these propagation delay times exceed the period of the highest required clock frequency, so a look-ahead system is used.

With a look-ahead system the re-loading procedure is stretched out over a number of clock pulses and reduces the effect of propagation delay times.

Normally the data input of the 'd-type' flip flop, IC11, is high until the outputs of IC14, 15, 16 and 17 are low and the clock pulse occurs to change the output of IC13 from 3 to 2, whereupon the data input goes low but the outputs of the 'd-type' remain unchanged because the clock pulse has already gone. When the next clock pulse comes along the data input is still low so the $\overline{Q}$ output of the flip flop goes high and loads the counters. This removes the low from the data input but is too late to change the $\overline{Q}$ output back, which remains high. The counters are unable to respond to the clock pulse since the load pulse is overriding it. The counters at this time would normally have counted to 1. The next clock pulse removes the load pulse from the counters but since its removal occurs slightly after the clock pulse the counters remain in their loaded state. The counters at this time would normally have counted to 0. The next clock pulse decrements the counters from the loaded information as normal. The advantage of this system is that the counters receive a load pulse the period of one complete input cycle and propagation delays are reduced to that of the 'd-type' clock/output which are much faster than a programmable counter.

Clock input

The output from the prescaler is at emitter coupled logic levels and is in the form of a differential signal to improve noise immunity. These are fed to a differential transistor amplifier the output of which is further amplified to cos/mos level by a cos/mos gate acting as a linear amplifier. The signal goes through another gate of which the other input is available for inhibiting clock pulses when it is taken low.

2. THE REFERENCE DIVIDER

The reference frequency of the synthesizer as mentioned is 100Hz but an industry standard of 2MHz exists. The reference is divided down by IC6, 7, 8 and 9 to 200Hz and down to 100Hz by $\frac{1}{2}$IC11, a 'd-type' flip flop connected to divide by 2.

3. THE FREQUENCY/PHASE DETECTOR

The inputs to the frequency/phase detector are the reference 100Hz and the load pulse. The output of the detector consists of two lines from pins 9 and 6 of IC2. If the load pulse frequency is higher than the reference frequency, pulses come out of pin 6 and pin 9 remains high. If the load pulse frequency is lower than the reference frequency pulses come out of pin 9 and pin 6 remains high. As the frequencies become the same, the width of pulse is proportional to the phase error between them. Provision is made to disable the pulses from progressing to the integrator. Note that the pulses from pin 6 are inverted before being applied to the integrator.

4. THE INTEGRATOR

The integrator, IC15, inverting input is connected to a reference of approximately +7.5V and the non-inverting input connected via resistors and diodes D1 and D2, to the frequency/phase detector outputs. For a load pulse in phase and at exactly the same frequency as that of the reference, the anode of D1 remains low, i.e. reverse biased and the cathode of D2 remains high, also reverse biased. As error pulses occur at either output, one or other of the diodes is forward biased. This causes the output of

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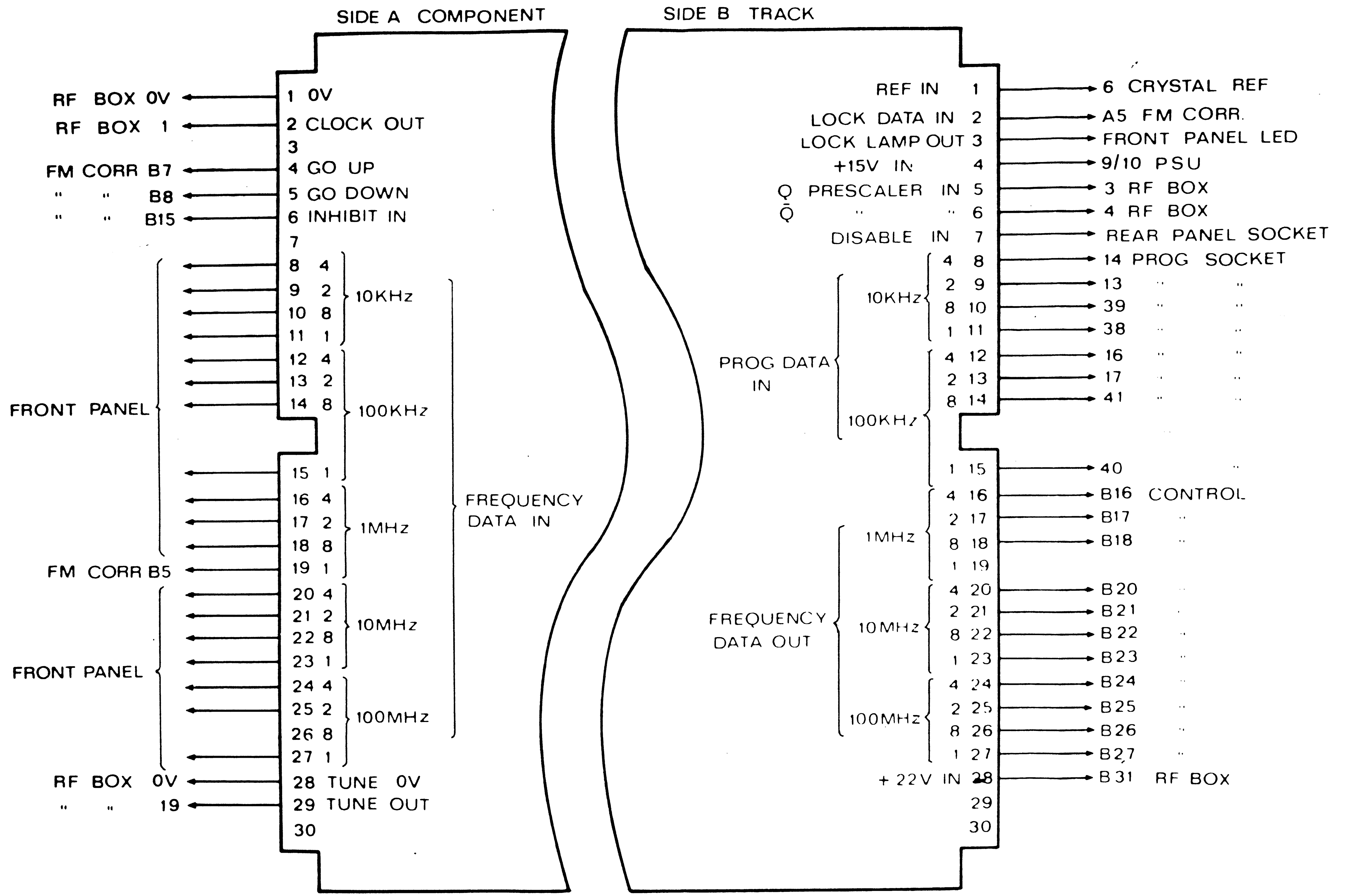

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NOTE

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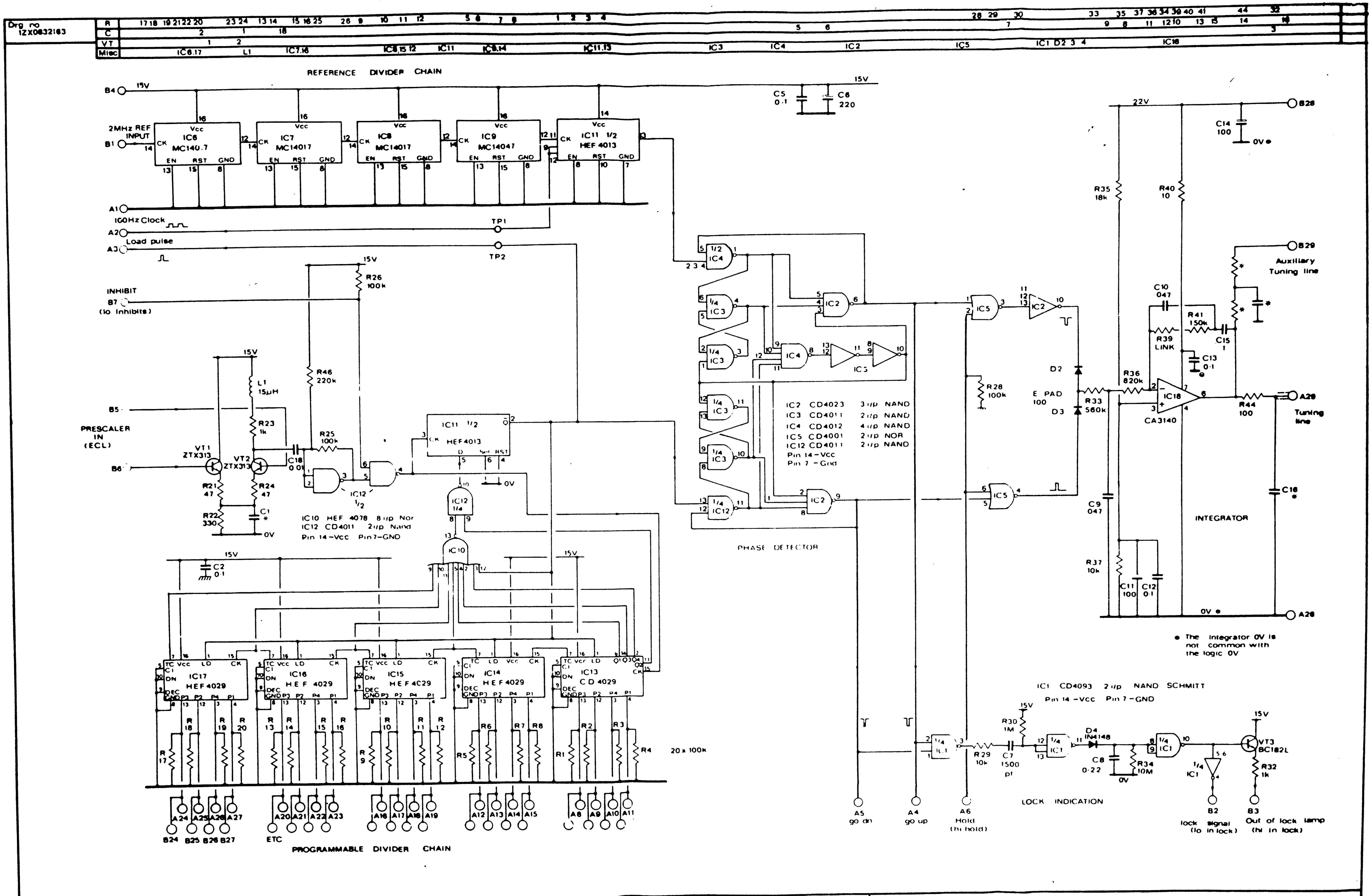
TITLE: SYNTHESIZER BOARD WIRING SSG520

DRAWING No.: 3ZV0832272

Section 10 issue 1 11·78



All Resistor values in ohms
All Capacitor values in µF, unless otherwise stated

O— Refers to c.b side and pin No.

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FARNELL INSTRUMENTS LTD. WETHERBY

Title: SYNTHESIZER SSG520

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The D/A converter consists of an R, 2R ladder network with resistance arms switched either to the input of the f.m. amplifier IC10 by one set of analogue gates controlled by the outputs of a seven bit binary counter or switched to ground by another set of analogue gates controllled by the invert of the counter outputs. In parallel with the R, 2R ladder is a 180kΩ resistor, R19. The effective resistance switched in between the input of the D/A converter and its output is dependent on the counter outputs and can vary from being 180kΩ and 127/128ths of 25kΩ in parallel with 180kΩ which is 21.8kΩ.

The f.m. amplifier has four functions, all of which drive the f.m. line of the oscillators. When the f.m. correction logic is in its reset mode the inverting input of the amplifier is connected to the output of the D/A converter, the non-inverting input is connected to 0V. The operational amplifier is acting as a virtual earth amplifier with its input resistor determined by the D/A converter and its feedback resistor is either 25kΩ or 2k5Ω. When the sweep sense switch is switched to 'sweep' the 25kΩ is switched in and the other feedback paths are switched to 0V, when switched to 'f.m.', the 2k5Ω resistor is switched in with the others switched to 0V. When the sweep/f.m. switched is switched to 'f.m.' and the f.m. on/off switch is set to 'off' then the 2k5Ω feedback resistor is switched across the amplifier but the D/A converter resistor ladder is disconnected and switched to ground. IC10 is effectively a voltage follower with the input connected to ground, therefore output is at ground. The reason for this is to remove the f.m. as near to the f.m. control line as is possible so that noise, showing up as residual f.m. is minimised. Thus in one mode when the 25kΩ feedback resistor is switched in, the f.m. amplifier has a gain of from 1.15 down to 0.14 depending on the setting of the seven bit counter. In another mode when the 2k5Ω feedback resistor is switched in, the gain is approximately from 0.15 to 0.014 (approximate because the analogue gate adds some resistance of its own to the feedback resistor which is significant compared with the 2k5Ω resistor). In another mode it is a voltage follower with its input grounded.

The fourth role of the f.m. amplifier is to act as the integrator of a phase locked loop system when the f.m. calibration is in its auxiliary loop sequence. In this instance the feedback resistors R22 and R23 are grounded, go-up pulses enter the inverting input via D1, go-down pulses via D2 and the integrating capacitor is C12. R38 and C13 form some phase advance to the circuit. Also at this time the non-inverting input of IC10 is connected to ½ the supply rail so that go-up and go-down pulses have equal effect. The D/A converter is disconnected from the inverting input and switched to ground.

When the MHz thumbwheels and above are changed the start latch is set. This substitutes the reference signal path for the f.m. signal, although the reference signal at this time is not present. The f.m. amplifier is set to its 'sweep' mode regardless of the sweep/f.m., or f.m. on/off switch settings. The D/A counter is reset so the input resistor to the f.m. amplifier it 180kΩ. The two d-type flip flops of IC21 which were in the reset condition have the reset removed. A very slow astable oscillator comprising ½IC16, C19, C20 and R47 has its reset removed and is used to time the f.m. calibration procedure so that if for some reason the f.m. calibration is not complete within about 8 seconds the falling edge of the oscillator retriggers the start latch so that the procedure starts again from the beginning. If, after the oscillator has been started, the thumbwheels are changed again the pulse thus generated is used to re-start the oscillator and to reset the d-type flip flops so that both the time and calibration procedure always start from the last change of thumbwheel setting.

Meanwhile the main synthesizer has gone out of lock (due to the thumbwheel change). When it comes into lock at the frequency set up on the thumbwheel switches (f. set) the 1st d-type's Q output goes hi due to its data input (the start latch output) being already hi. As this occurs the reset on the D/A counter is removed and the MHz thumbwheel setting is moved to 1MHz away.

This is achieved by taking the signal from the 'a' bit of the a, b, c, d outputs of the thumbwheel into an exclusive OR gate and from the output of this gate to the synthesizer. When the second input of the exclusive OR gate is low, the output follows the logic state set on the 1st input and hence the thumbwheel switch. When the second input is hi the output is the invert state of the thumbwheel input so the synthesizer is set to a frequency 1MHz away from that set on the thumbwheels.

The main synthesizer integrator is inhibited and the f.m. amplifier is switched into its auxiliary synthesizer loop state. The part of the main synthesizer which is still working goes out of lock, due to the effective frequency change, with the auxiliary loop trying to find lock at f.set ±1MHz by moving the f.m. line in the appropriate direction.

The f.m. amplifier output is at the moment connected to the non-inverting input of the trigger amplifier, IC14, and to a storage capacitor, C11, through a resistor and an f.e.t. switch. The inverting input of this I.C. is connected to -15V via R32 because the f.e.t. switch connecting it to the f.m. amplifier output is turned off, its output is therefore hi.

When the auxiliary loop comes into lock at f.set ±1MHz the Q output of the second flip flop goes hi. This disconnects the non-inverting input and connects the inverting input of the trigger amplifier to the f.m. amplifier output, but the voltage that was previously on the f.m. line is stored on the storage capacitor of C11. Simultaneously the f.m. amplifier is restored to its 'sweep' position, an oscillator which provides a clock pulse for the D/A counter and also after being differentiated provides the reference for the input amplifier is enabled, the synthesizer setting is returned to f.set and the main synthesizer loop inhibit is removed. The gate enabling the reset of the start latch is enabled after the delay created by C22 and R53. (The delay is necessary so that when the inputs of the trigger amplifier are changed over this possible disturbance does not reset the start latch).

As the clock of the D/A counter continues the counter increments and the effective input resistance of the f.m. amplifier gradually decreases, therefore the gain increases and the output signal increases as a positive and negatice spike progressively getting larger until such a point is reached when their amplitude exceeds that stored on the storage capacitor C11. When this occurs, the output of the trigger amplifier changes state. (The direction this takes is the opposite to the direction the auxiliary loop had to go to bring the synthesizer into lock).

If the change is from negative to positive then it is transmitted through C9 and D5 through the NAND gate, now enabled to reset the start latch. If from positive to negative it goes through an inverting gate whose input is protected from the negative excursion by R35 and D4, through C8 and D3 through the NAND gate to the start latch. When this occurs the f.m. amplifier is returned to the mode specified by the sweep/f.m. and f.m. on/off switches, the input amplifier has the f.m. signal path connected to its input, the oscillator acting as the timer for the whole process is cancelled, the two d-type flip flops are reset and the gate enabling the reset of the start latch is disabled allowing the start latch to be set if the thumbwheel switches are changed again. The clock, incrementing the D/A counter is stopped and the counter remains set at this level. This means that an input signal of the same peak amplitude as the reference signal with the sweep mode selected should give a peak f.m. deviation of 1MHz, or 100kHz in the f.m. mode. P1 is adjusted to give this level. Meanwhile, the main synthesizer loop has been finding lock again at f.set. The cycle of f.m. calibration is completed.

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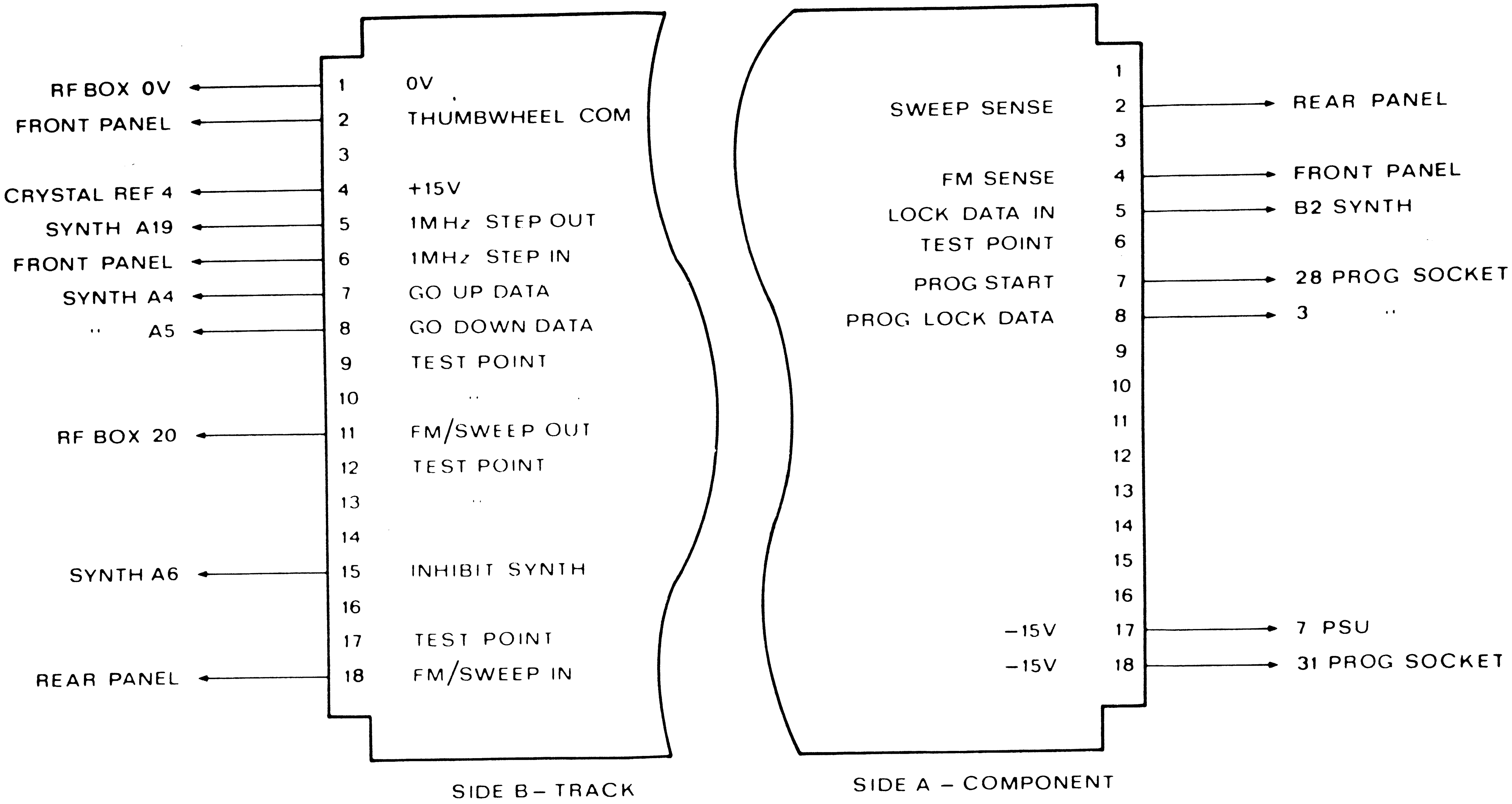

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DIMENSIONS IN MM | SCALE

FARNELL INSTRUMENTS LTD WETHERBY

TITLE
FM CORRECTION BOARD
WIRING SSG520
Section 11 issue 1 11·78

DRAWING NO
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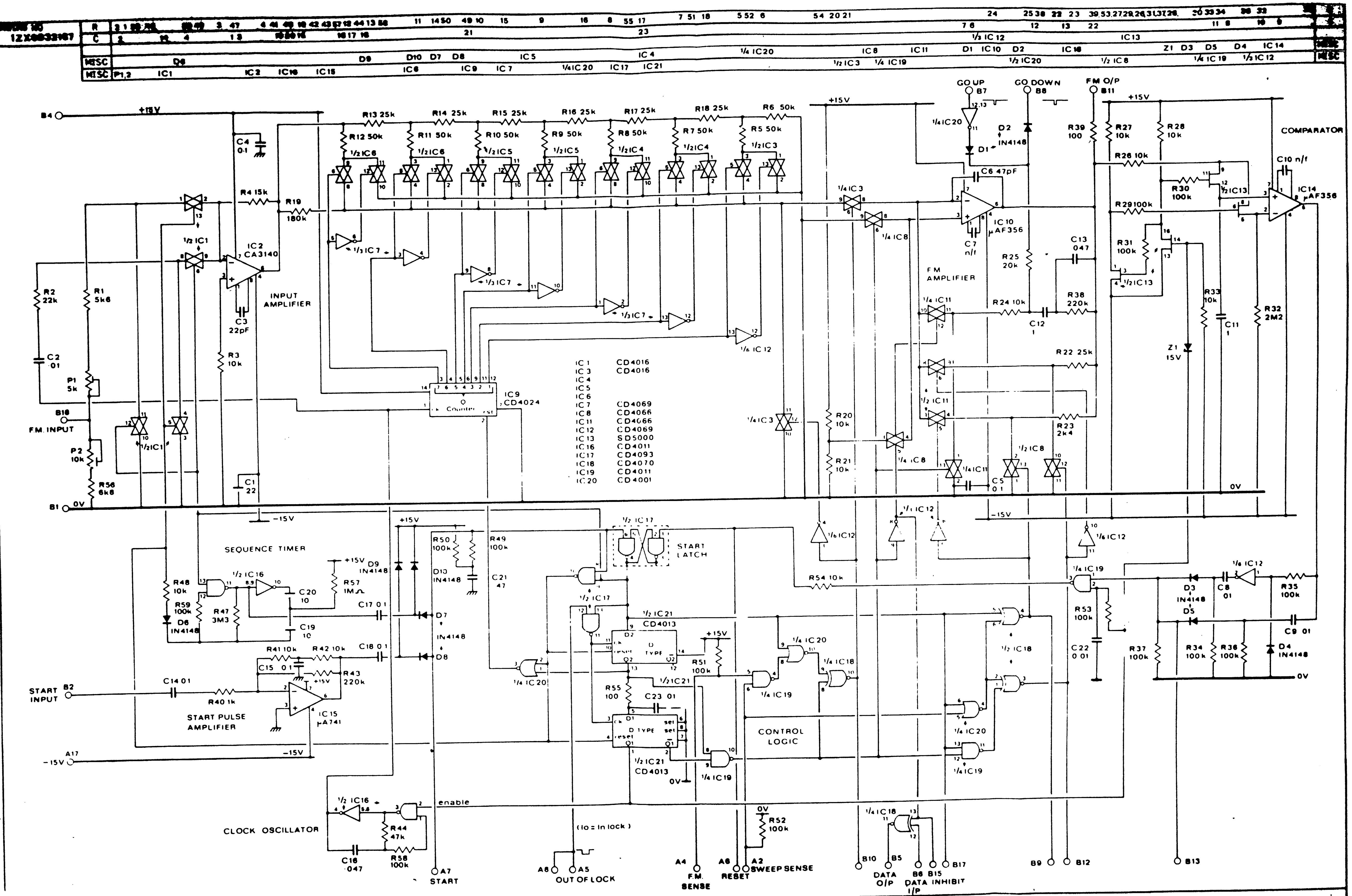
SHEET OF SHEETS



RESISTOR VALUES IN OHMS Ω
CAPACITOR VALUES IN μF
○ A REFERS TO COMPONENT SIDE EDGE CONNECTOR PIN NUMBER
○ B · TRACK SIDE · · ·

ISSUE	DATE	MOD No.
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SCALE

DIMENSIONS IN MM

TITLE CIRCUIT DIAGRAM FM CORRECTION SSG520 *Section 11 issue 1 11-78*

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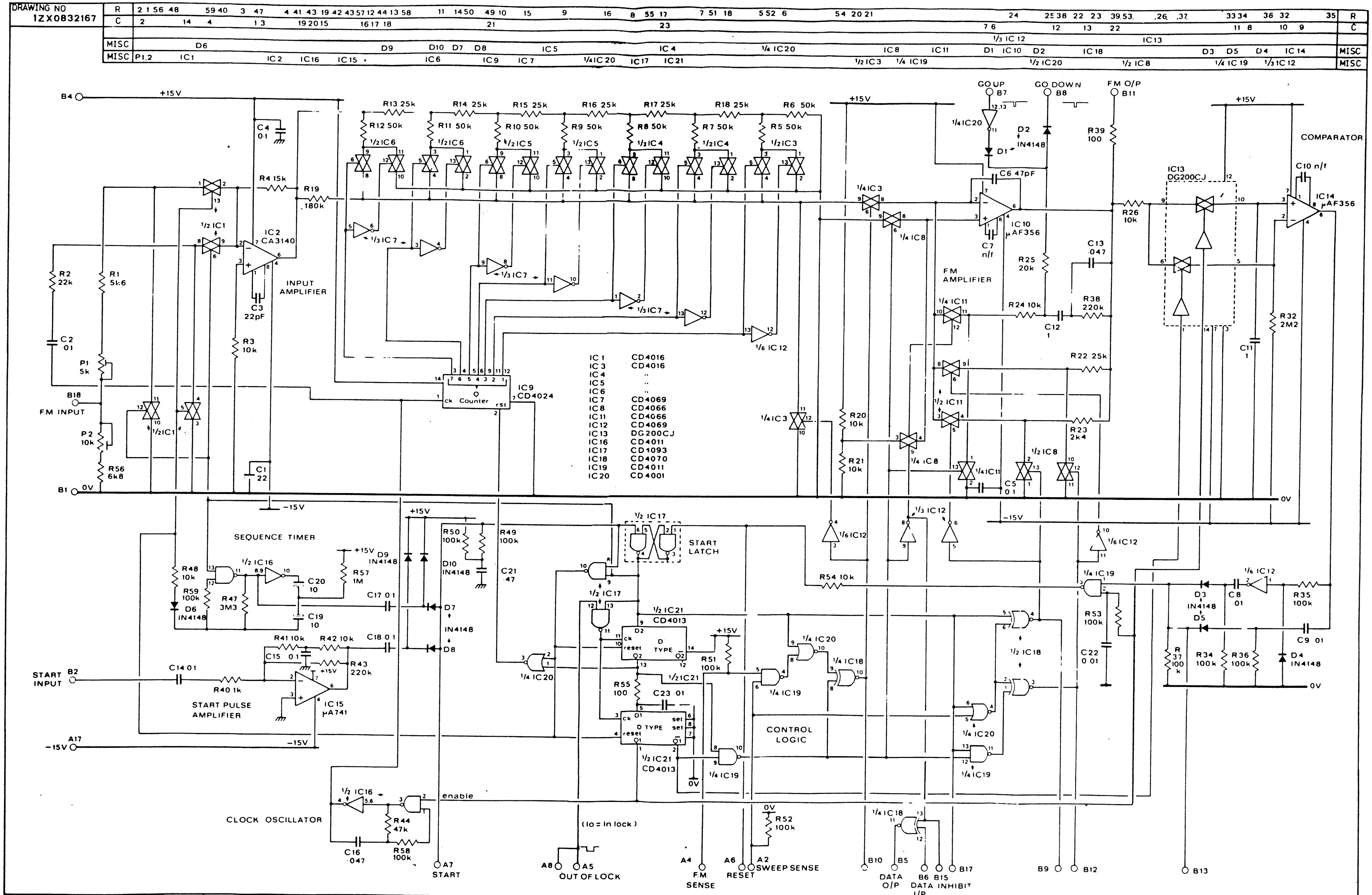


RESISTOR VALUES IN OHMS Ω
CAPACITOR VALUES IN μF
○ A REFERS TO COMPONENT SIDE EDGE CONNECTOR PIN NUMBER
○ B - TRACK SIDE - - - -

Section 11 issue 2 5.81

TITLE CIRCUIT DIAGRAM FM CORRECTION SSG520

DRAWING No 1ZX0832167

SCALE | DIMENSIONS IN MM

THE AUDIO AND SINAD BOARD

On this board is the modulation source, general audio function management and the SINAD measuring section.

Two modulation frequencies are available, switched by relays. The oscillator buffer amplifier IC12 isolates the internal circuits from any load placed on the modulation output.

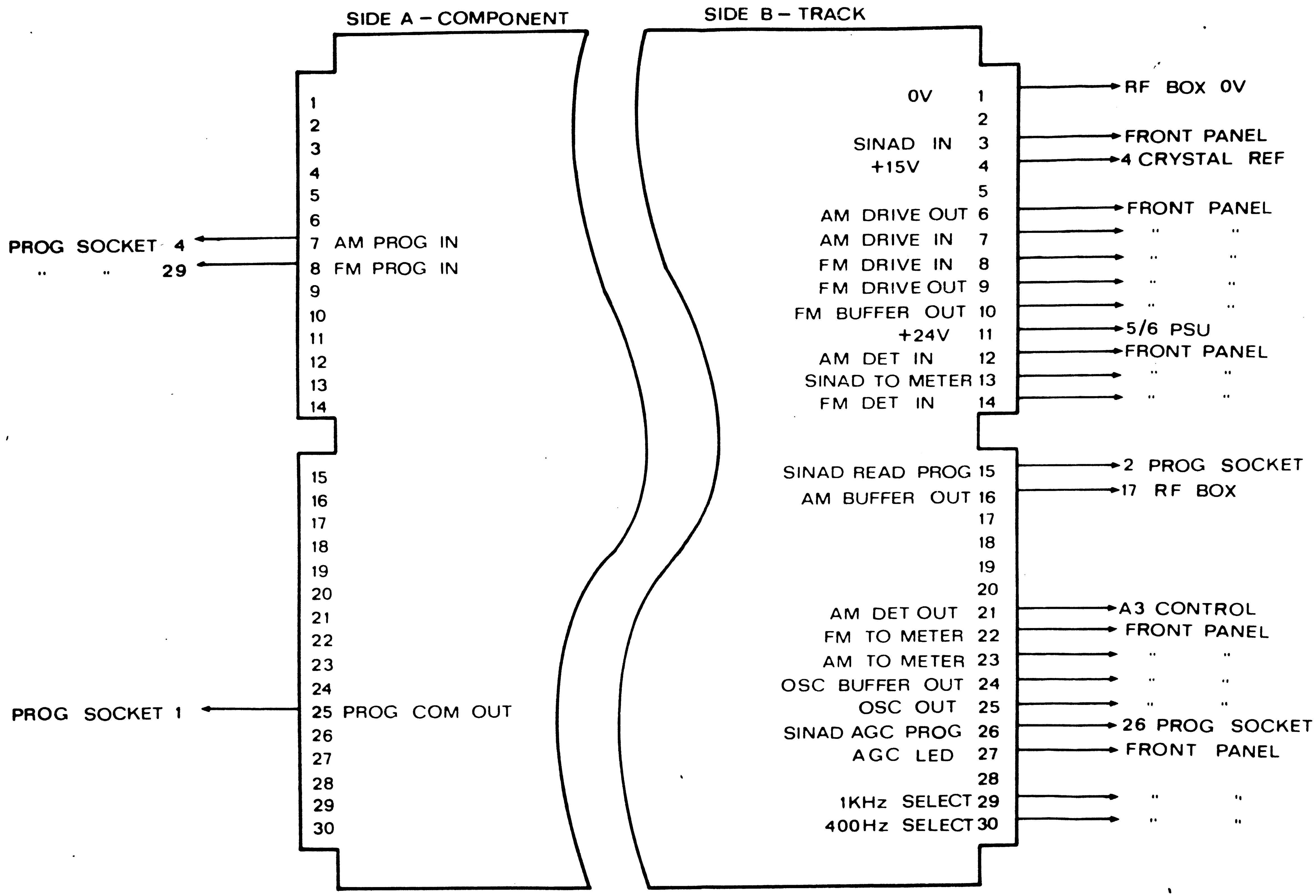
After modulation selection by the switches on the front panel, two further amplifiers, the f.m. driver IC14 and the a.m. driver IC18, feed the modulation level potentiometers. The a.m. buffer amplifier IC18 then isolates the audio board circuits from the amplitude modulator in the r.f. box. The f.m. buffer amplifier IC15 isolates the audio board from the f.m. range switch and f.m. connection board.

The SINAD meter is in effect an automatic 1kHz distortion analyser. The 1kHz tone is set to a fixed level by the two stage average responding input a.g.c.. IC1 and IC3 are the amplifiers with their output levels detected by D1/D2 and D3/D4 respectively. The diode d.c. outputs are amplified by IC2 and IC4, these amplifiers driving the gain control f.e.t.s VT1 and VT2. An out of range circuit is provided to detect correct a.g.c. operation and illuminates an l.e.d. when the input signal level is suitable.

The 1kHz fundamental is then notched out by IC5 and IC6 which form a Wien bridge type of notch filter. IC8 and IC9 average detect the remaining audio signal level and display on the front panel meter.

The 1kHz audio oscillator of Wien bridge type uses identical value and type frequency defining components as the notch filter. These components are positioned in close proximity on the circuit board thus giving temperature independence of the frequency tuning.

DRAWING No.
3ZV0832273



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CHECKED		B 4919
DRAWN	J.N	ISS / DATE / MOD No.
		A 19.6.7? –

NOTE

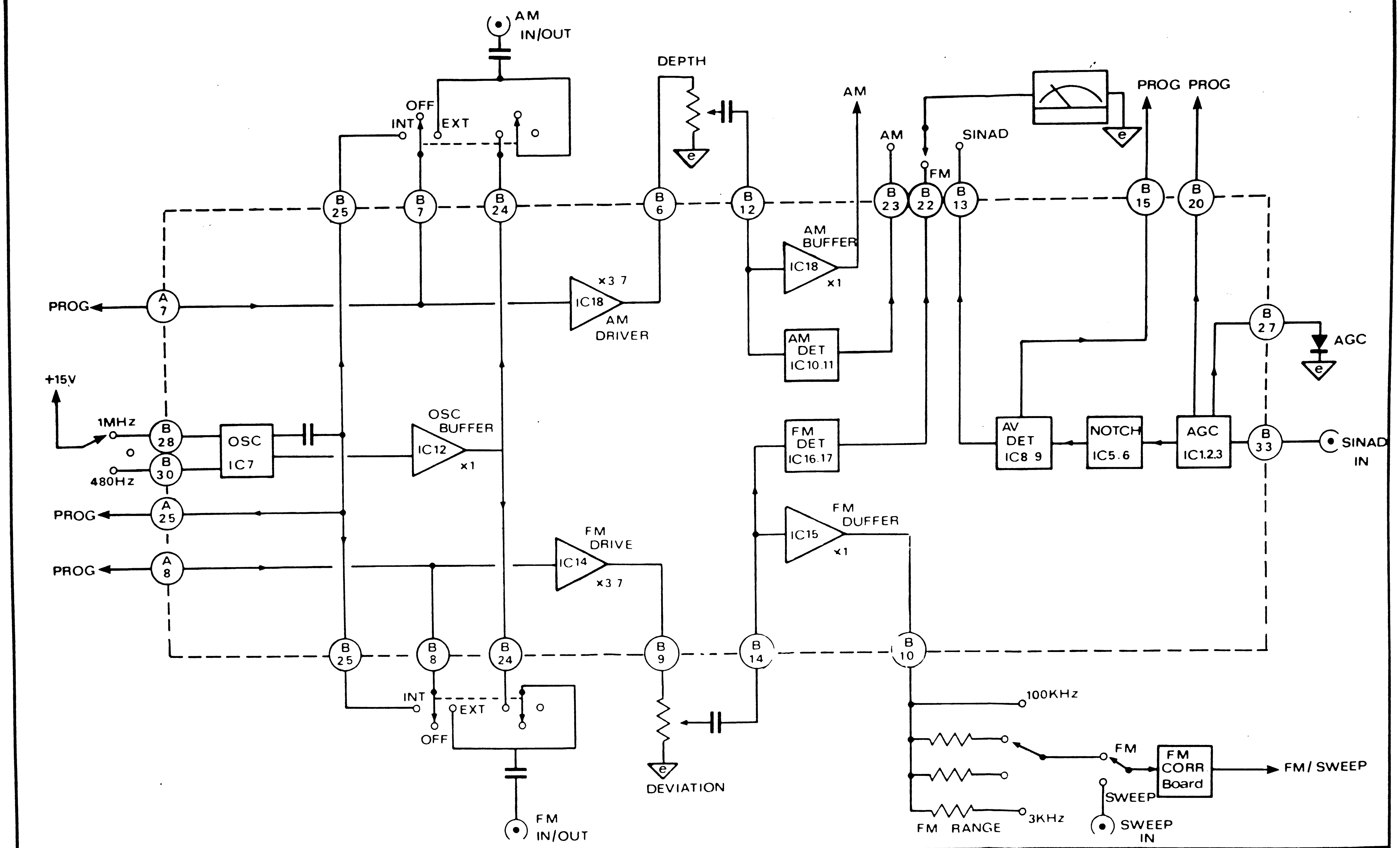
FARNELL INSTRUMENTS LTD. WETHERBY.

TITLE AUDIO BOARD WIRING SSG520

DRAWING No 3ZV0832273

Section 12 issue 1 11·78

USED ON	DRAWING No
	3ZV0832283



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DRAWN	J.N.	ISS	DATE	MOD No
		A	19.6.78	—

FARNELL INSTRUMENTS LTD. WETHERBY

TITLE AUDIO BOARD BIOCK DIAGRAM

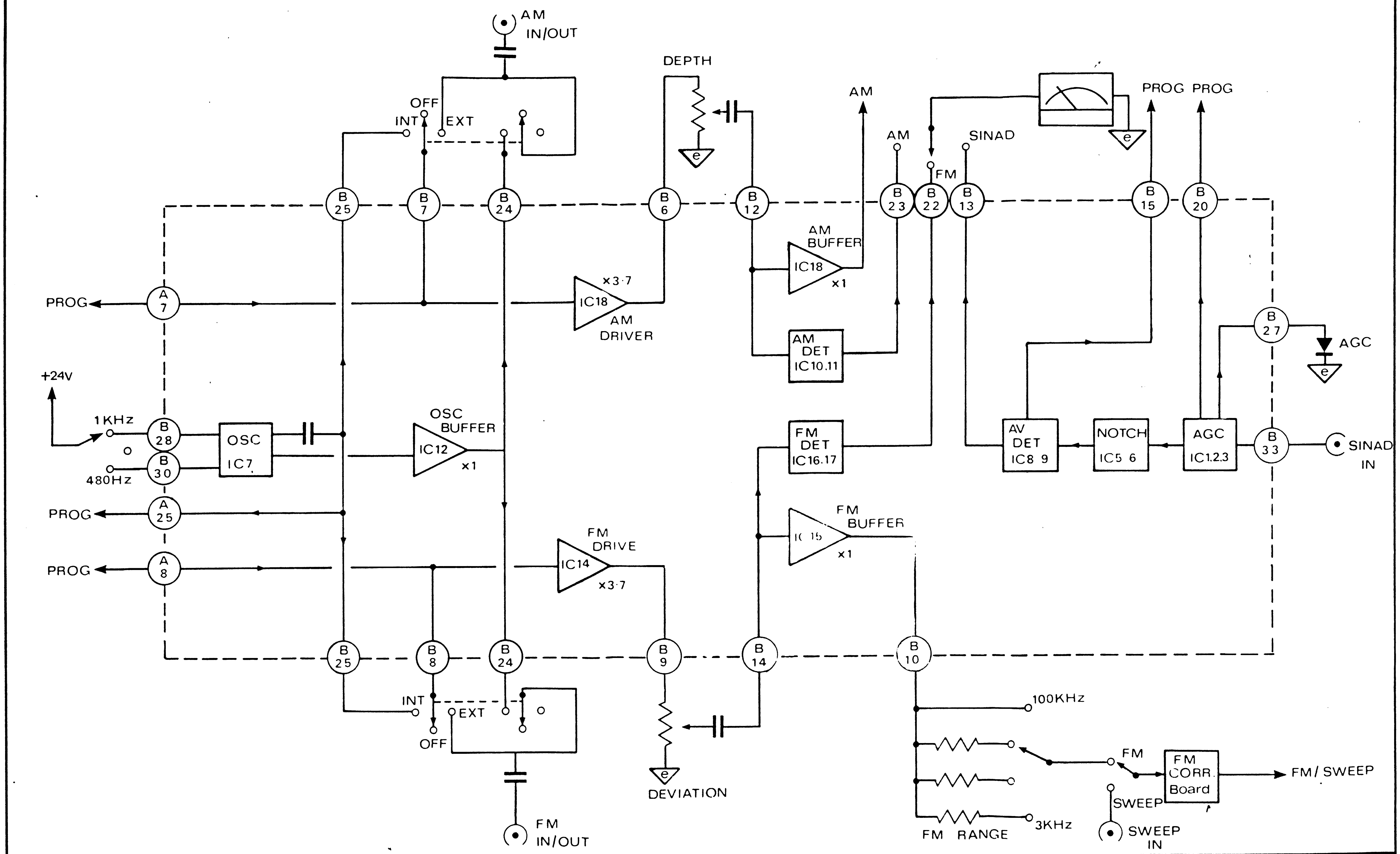
SSG520

DRAWING No 22V0832283

Section 12 issue 1 11·78

USED ON

DRAWING No
3ZV0832283



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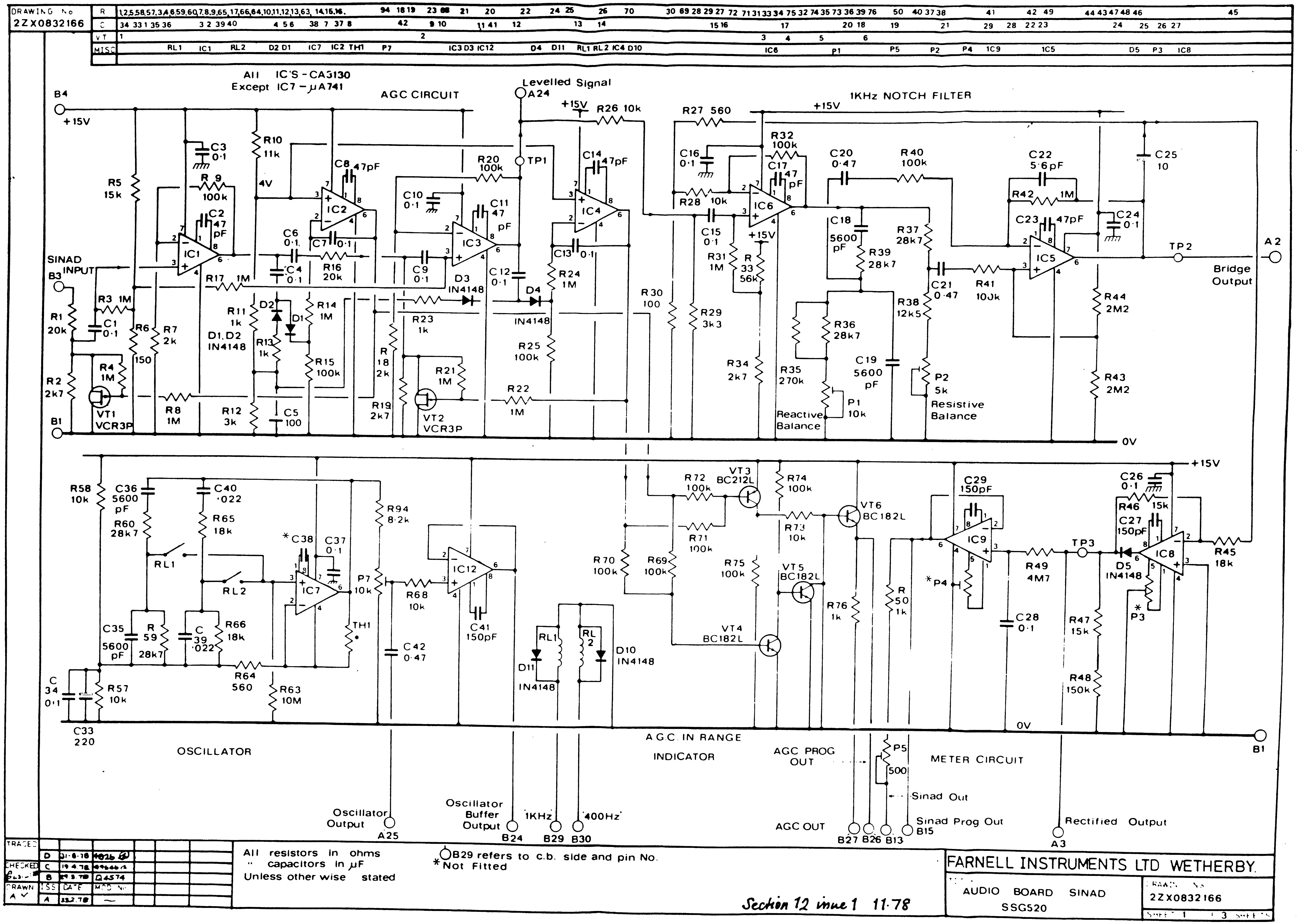
CHECKED		C	5.3.79	S351	
		B	15JAN79	S243	
DRAWN	J.N.	ISS	DATE	MOD No	
		A	19.6.78	—	

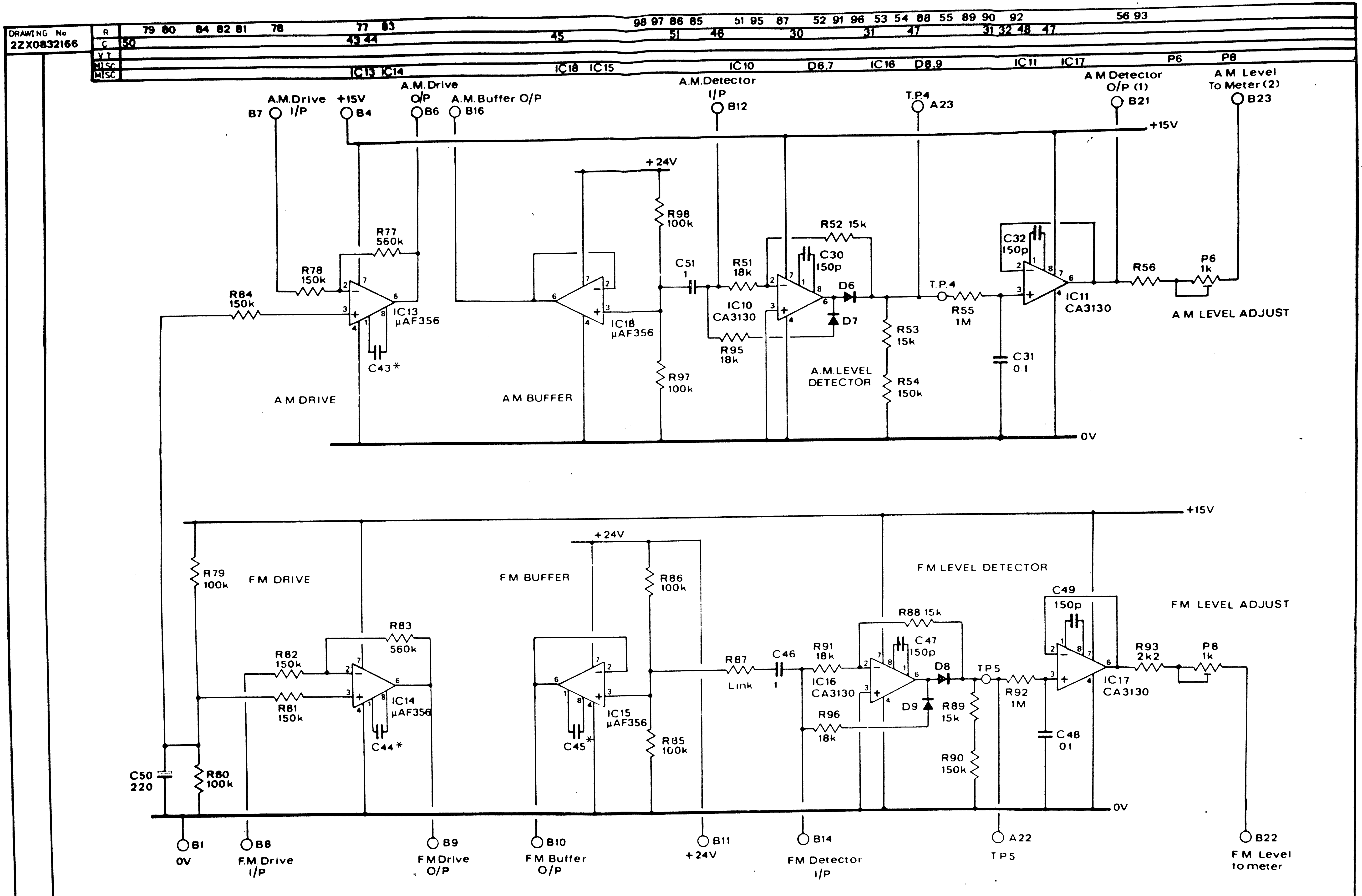
FARNELL INSTRUMENTS LTD. WETHERBY

TITLE AUDIO BOARD BLOCK DIAGRAM
SSG520

DRAWING No
3ZV0832283



All IC'S - CA3130
Except IC7 - μA741
AGC CIRCUIT
Levelled Signal
A24
1KHz NOTCH FILTER
+15V
0V
SINAD INPUT
B3
B4
B1
A2
Bridge Output
TP1
TP2
TP3
Reactive Balance
Resistive Balance
OSCILLATOR
AGC IN RANGE INDICATOR
AGC PROG OUT
METER CIRCUIT
Oscillator Output
A25
Oscillator Buffer Output
B24
1KHz
B29
400Hz
B30
AGC OUT
B27
B26
B13
Sinad Out
Sinad Prog Out
B15
Rectified Output
A3
All resistors in ohms
" capacitors in μF
Unless other wise stated
B29 refers to c.b. side and pin No.
* Not Fitted
Section 12 issue 1 11·78
FARNELL INSTRUMENTS LTD WETHERBY.
AUDIO BOARD SINAD
SSG520
DRAWING No
2ZX0832166
SHEET 1 OF 3 SHEETS



TRACED		
CHECKED		
DRAWN A.M.	ISS A	DATE 26.1.78	MOD No.

All resistors in ohms
" capacitors in µF
Unless otherwise stated

All diodes are IN4148
* Not fitted
B11 ○ Refers to c.b. side and edge connector no

Section 12 mul 11·78

FARNELL INSTRUMENTS LTD WETHERBY

TITLE AUDIO BOARD DRIVE AND BUFFER AMPS

DRAWING No 2ZX0832166

SHEET 2 OF 3 SHEETS

THE CRYSTAL REFERENCE BOARD

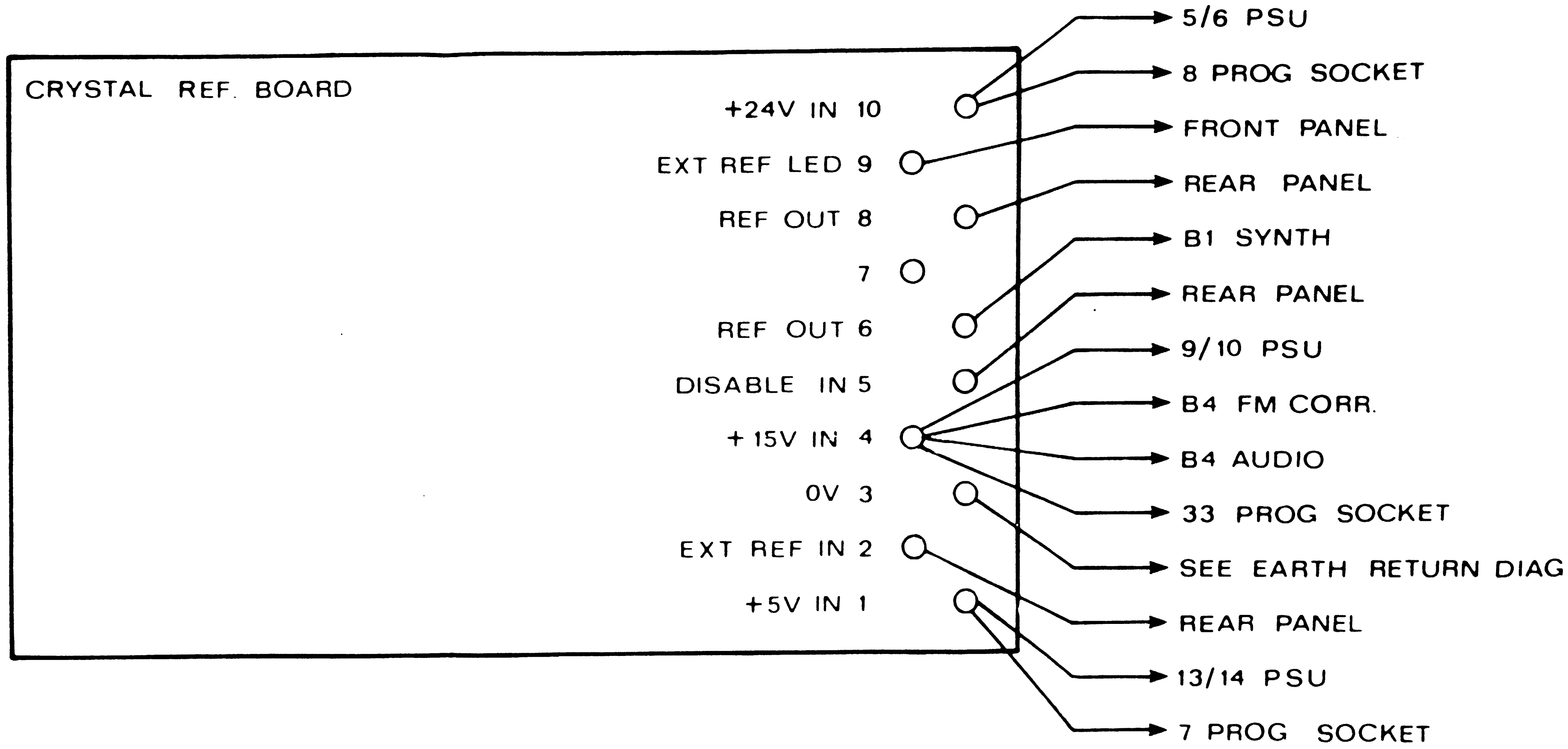
The reference board is designed to accept several alternative crystal oscillator options. Either an ordinary crystal may be fitted or a crystal oven unit with or without fine tuning control.

IC1 forms the oscillator in the first case or an amplifier in the other cases. An external reference signal passes through three gain stages (IC1) before being doubled in frequency by toggling IC2 directly and via an inverter (IC1).

The final section of IC1 drives the detector diode D1 which gates off the output of the internal crystal oscillator unit and substitutes the external reference signal (IC2). This gating signal also operates the front panel l.e.d.

The internal oscillator can also be disabled by a further input from the rear panel for slow sweep purposes.

DRAWING No.
3ZV0832275



TRACED				
CHECKED				
DRAWN	J.N.	ISS	DATE	MOD No
		A	19-6-78	

NOTES

FARNELL INSTRUMENTS LTD. WETHERBY.

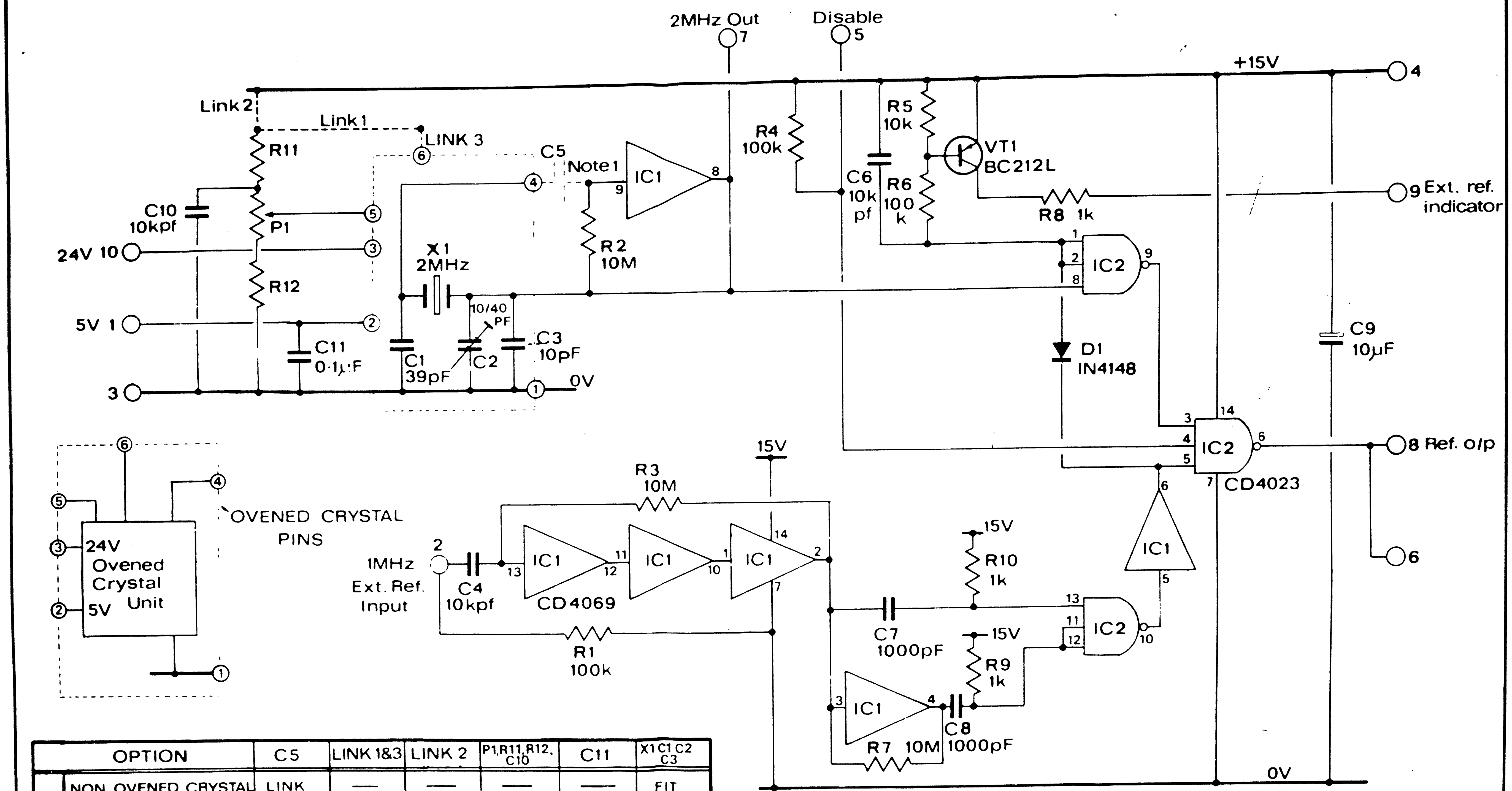
TITLE: CRYSTAL REF BOARD WIRING SSG520

DRAWING No. 3ZV0832275

Section 13 issue 1 11.78

DRAWING No. 3ZX0832164

R	11 12 2 1 3 4 7 5 6 10 9 8 9
C	10 11 1 2 4 3 10 6 7 8 1
VT	1
MISC	P1 X1 IC1 D1 IC2



OPTION		C5	LINK 1&3	LINK 2	P1,R11,R12, C10	C11	X1 C1 C2 C3
	NON OVENED CRYSTAL	LINK	—	—	—	—	FIT
A	4 PIN OVENED CRYSTAL	01uF	—	—	—	FIT	—
	5 PIN OVENED CRYSTAL VARACTOR TRIMMED	01uF	—	LINK	FIT	FIT	—
	6 PIN OVENED CRYSTAL VARACTOR TRIMMED	01uF	LINK	—	FIT	FIT	—

NOTE: ALL RESISTORS IN OHMS UNLESS OTHERWISE STATED

FARNELL INSTRUMENTS LTD. WETHERBY.

TITLE: REF OSCILLATOR BOARD
BATCH 4 ONWARDS SSG520

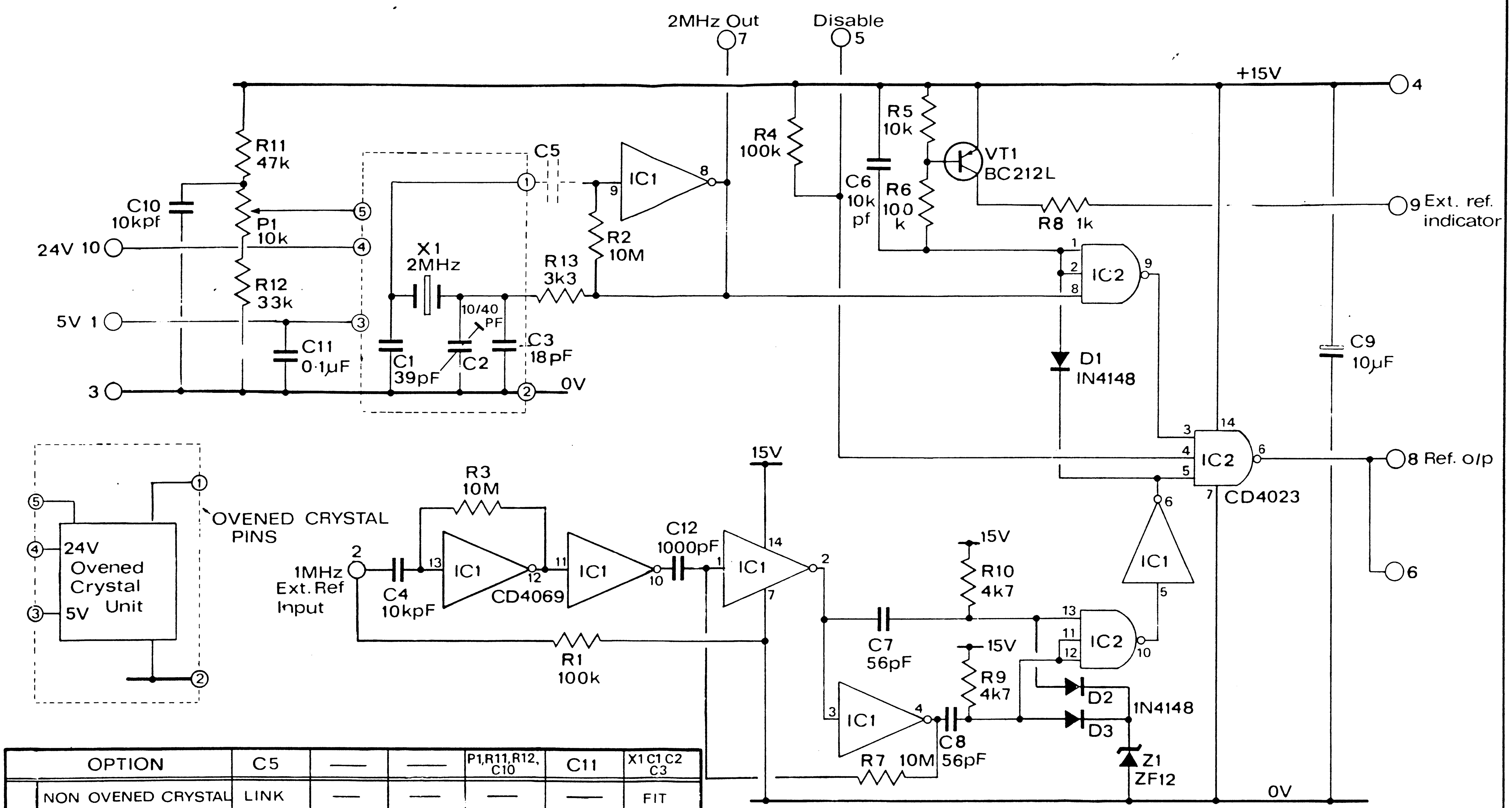
DRAWING No. 3ZX0832164 — Section 13 issue 1 11·78

SHEET OF SHEET

TRACED	CHECKED	DRAWN	ISS	DATE	MOD No
		J.N	D	20.7.78	4805

DRAWING No 3ZX0832164

R	11 12 · 13 2 1 · 3 · 4 · 7 5 6 · 10 9 · 8
C	10 · 11 · 1 · 2 4 3 · 10 · 6 7 · 8 · 9
VT	1
MISC	P1 · X1 · IC1 · D1 · IC2



OPTION		C5	—	—	P1,R11,R12, C10	C11	X1 C1 C2 C3
	NON OVENED CRYSTAL	LINK	—	—	—	—	FIT
	——	——	—	—	—	——	——
A	5 PIN OVENED CRYSTAL VARACTOR TRIMMED	·01uF	—	——	FIT	FIT	—

	ISS	DATE	MOD No
TRACED	H	3·5·79	5492
	G	31-3-79	5416, 5416
CHECKED	F	5.3.79	5351 [illegible]
	E	10.3.n.79	5041 [illegible]
DRAWN J N	D	20.7.78	4805

NOTE
ALL RESISTORS IN OHMS UNLESS OTHERWISE STATED

FARNELL INSTRUMENTS LTD. WETHERBY.

TITLE
REF OSCILLATOR BOARD (CATHODEON) SSG520

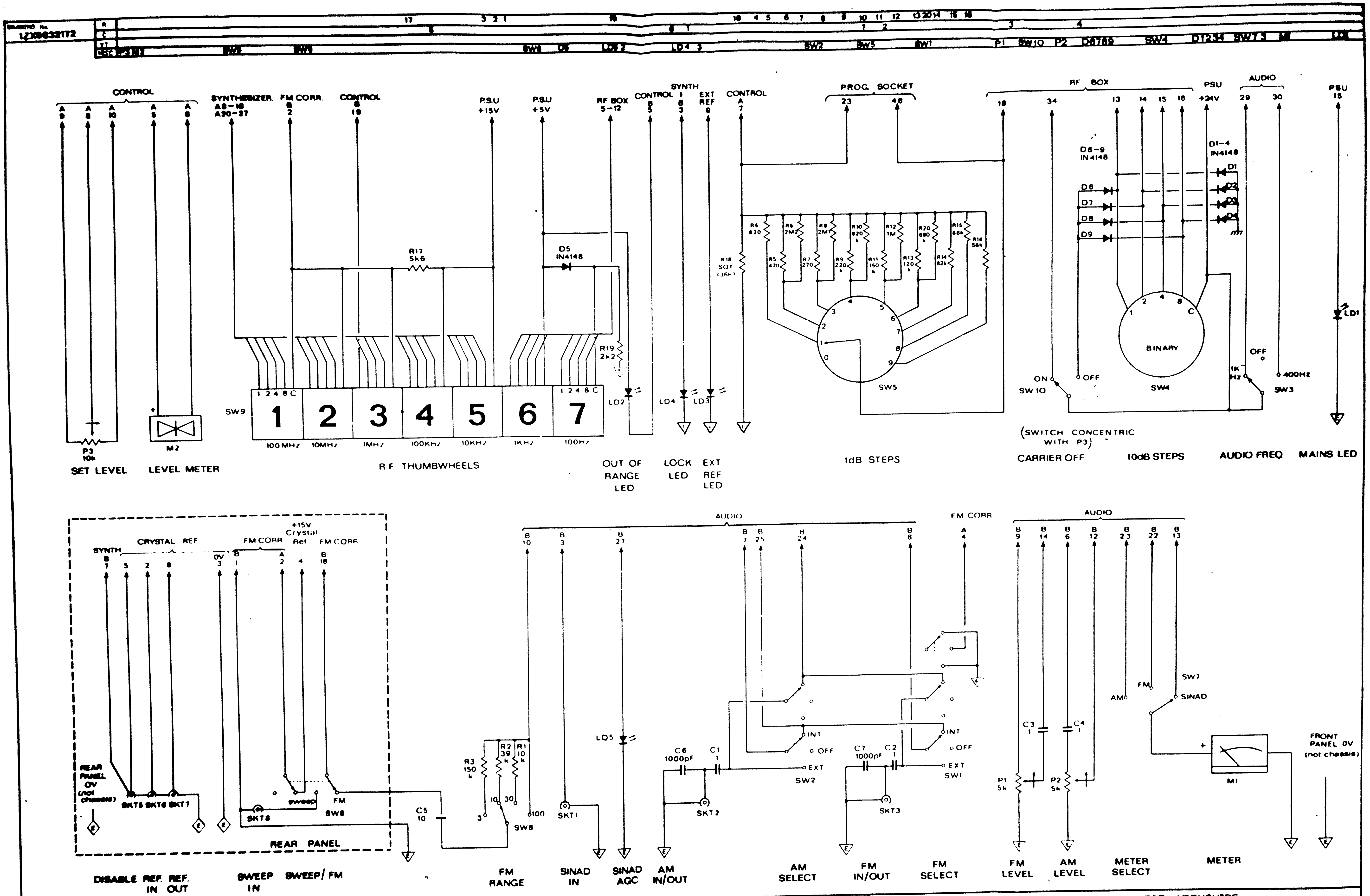
DRAWING No 3ZX0832164

SHEET 1 OF 1 SHEETS

THE FRONT AND REAR PANELS

To avoid any currents flowing through the instrument case, no components on the front and rear panels, with the exception of the r.f. output connector and the multipin programme socket (if fitted) are connected directly to the chassis. All 0V points are taken back to the circuit boards via the wiring loom. There are earth common points on the r.f. box.

Control	Switch type	Load
Frequency thumbwheels	7 decade, 4 line b.c.d.	d.c. levels
10dB steps	12 position, 4 line binary	"
1dB steps	1 pole 10 way rotary	"
Set level/carrier off	Potentiometer concentric with 1 pole 2 way rotary switch	"
FM select	3 pole 2 way centre off toggle	audio
AM select	2 pole 2 way centre off toggle	"
FM range	1 pole 4 way rotary	"
AM level	potentiometer	"
FM level	"	"
Meter select	1 pole 3 way rotary	d.c. levels
Audio frequency select	1 pole 2 way centre off toggle	"
Sweep/f.m. select	2 pole 2 way locking toggle	audio



NOTE
Resistor values in ohms
capacitor - - μF
unless otherwise stated

FARNELL INSTRUMENTS LTD. WETHERBY, WEST YORKSHIRE

TITLE FRONT AND REAR PANEL CIRCUIT DIAGRAM

SSG520

Section 14 wire1 11·78

DRAWING No 1ZX0832172

SHEET 1 OF 1 SHEETS

THE POWER SUPPLY AND POWER DISTRIBUTION SYSTEM

The power supply consists of five separate regulated voltage rails. All outputs are short circuit protected. The +22 volt rail is adjustable over a limited range and is provided solely to drive the r.f. V.C.O.s and the synthesizer output integrator. The supply is also double regulated to give maximum isolation of these circuits from the rest of the instrument. The +5 volt rail is also adjustable so the output can be set accurately to give the correct supply voltage on the high speed divider circuits in the r.f. box.

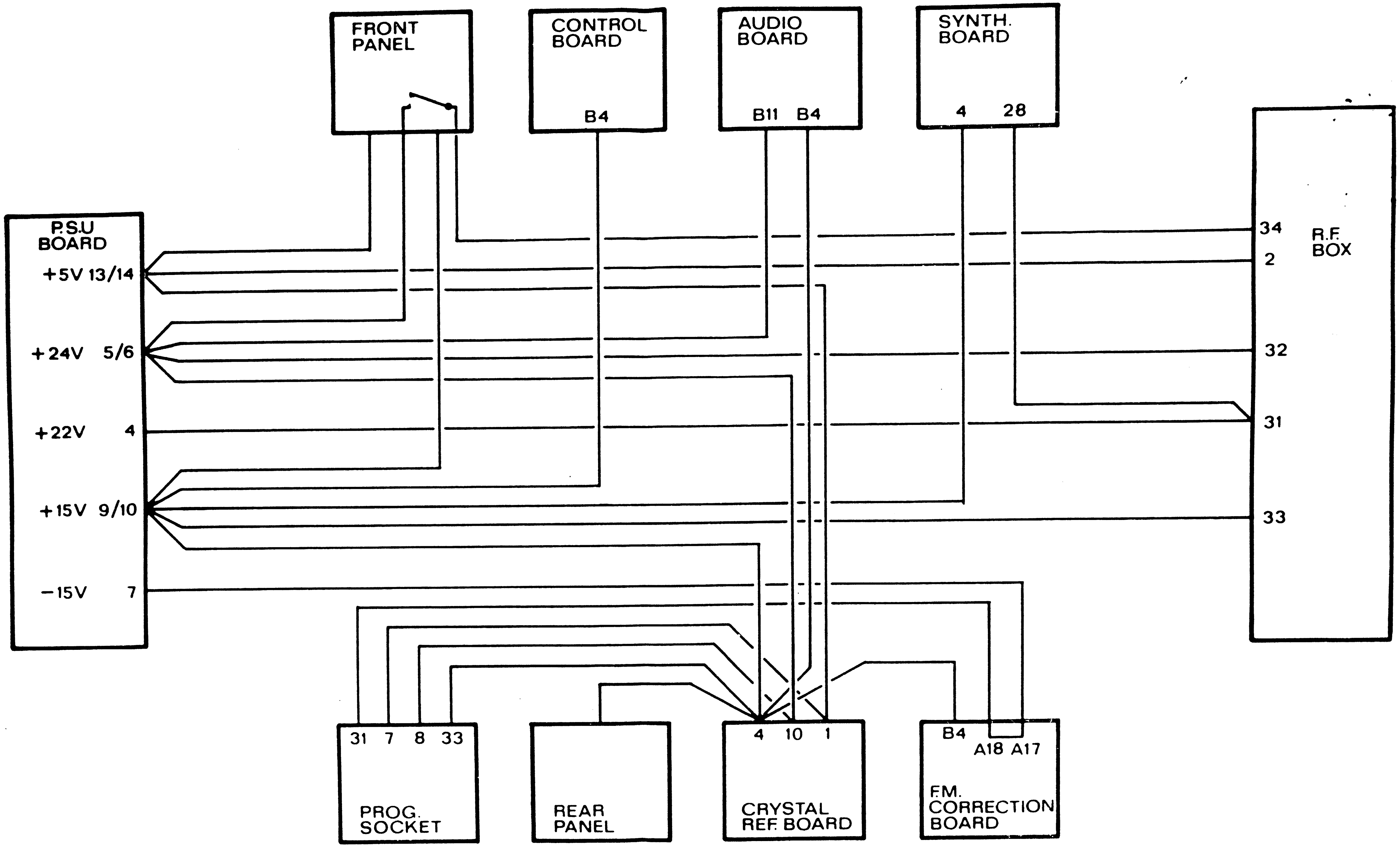
A toroidal mains transformer is fitted to keep down stray fields and improve efficiency. The mains input is also filtered to protect the instrument from external mains borne spurious.

A very clearly defined system of earth returns is employed throughout the instrument mainframe to avoid earth loops. All supply 0 volt lines are taken separately from the power supply unit and earthed to the chassis on the r.f. box. All circuit boards and the front and rear panels have their 0 volt lines connected in such a way that each board has only one return current path back to the r.f. box and wherever necessary separate paths. These paths never cause current to flow through chassis metalwork except the single piece r.f. box lid, where they are all connected on four earth tags.

In a similar way the supply lines to the circuit boards and r.f. box are taken separately from the power supply unit wherever possible. This means each board is isolated from the others and referenced back independently to the power supply regulators with no high current common mode supply paths.

This earth return system and supply isolation technique is of particular relevance to the +22 volt V.C.O. supply. As an additional precaution these supply lines are wired in screened cable.

DRAWING NO.
3ZV0832278



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CHECKED						
DRAWN	ISS	DATE	MOD. NO.			
	A	2.5.78				

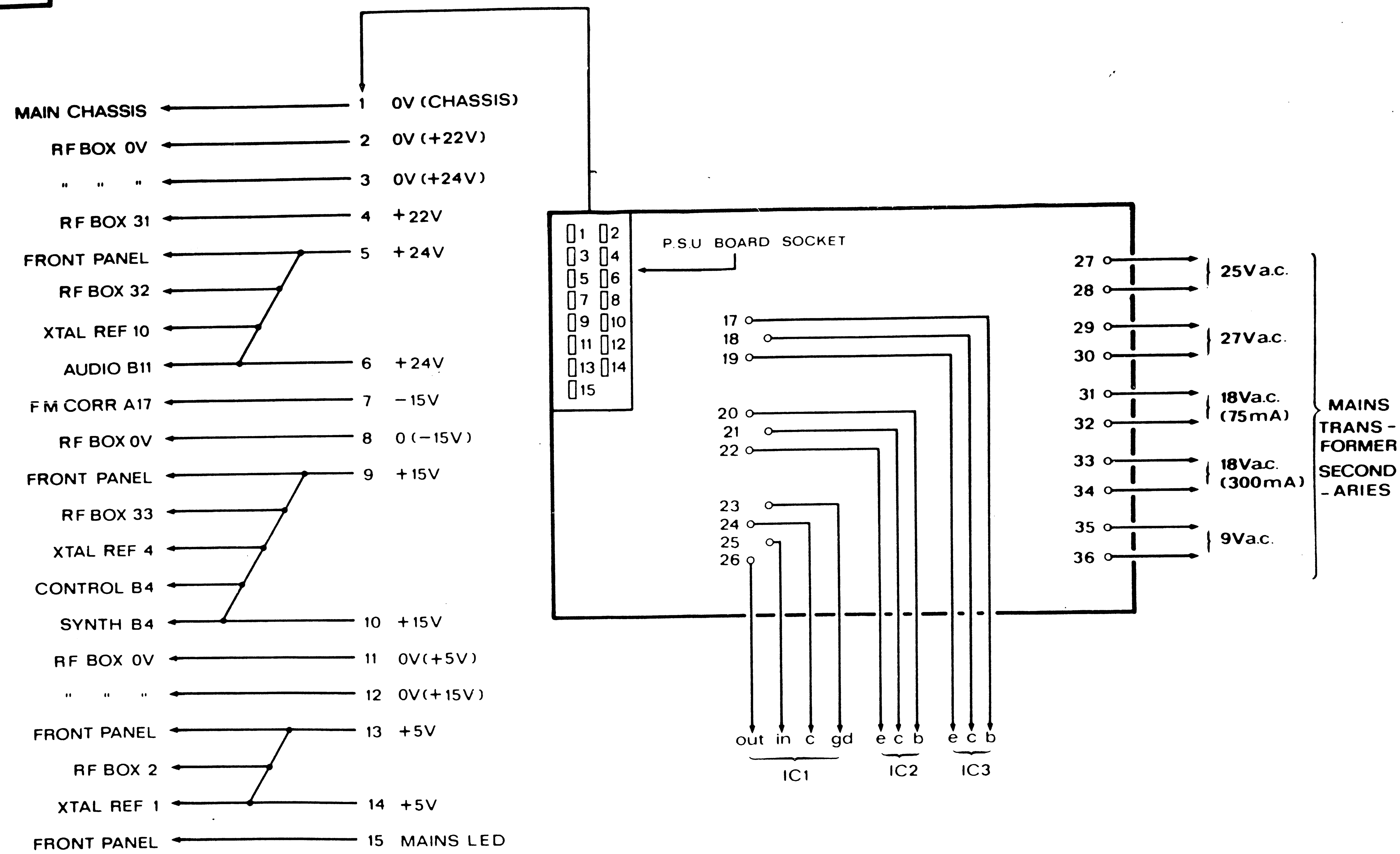
FARNELL INSTRUMENTS LTD. WETHERBY.

TITLE
POWER SUPPLY ROUTING
SSG 520 *Section 15 issue 1 11.78*

DRAWING NO.
3ZV0832278

SHEET OF SHEETS

DRAWING NO
3ZV0832280



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CHECKED							832
DRAWN	ISS	DATE	MOD NO				
	A	2.5.78					

Section 15 issue 1 11·78

FARNELL INSTRUMENTS LTD. WETHERBY.

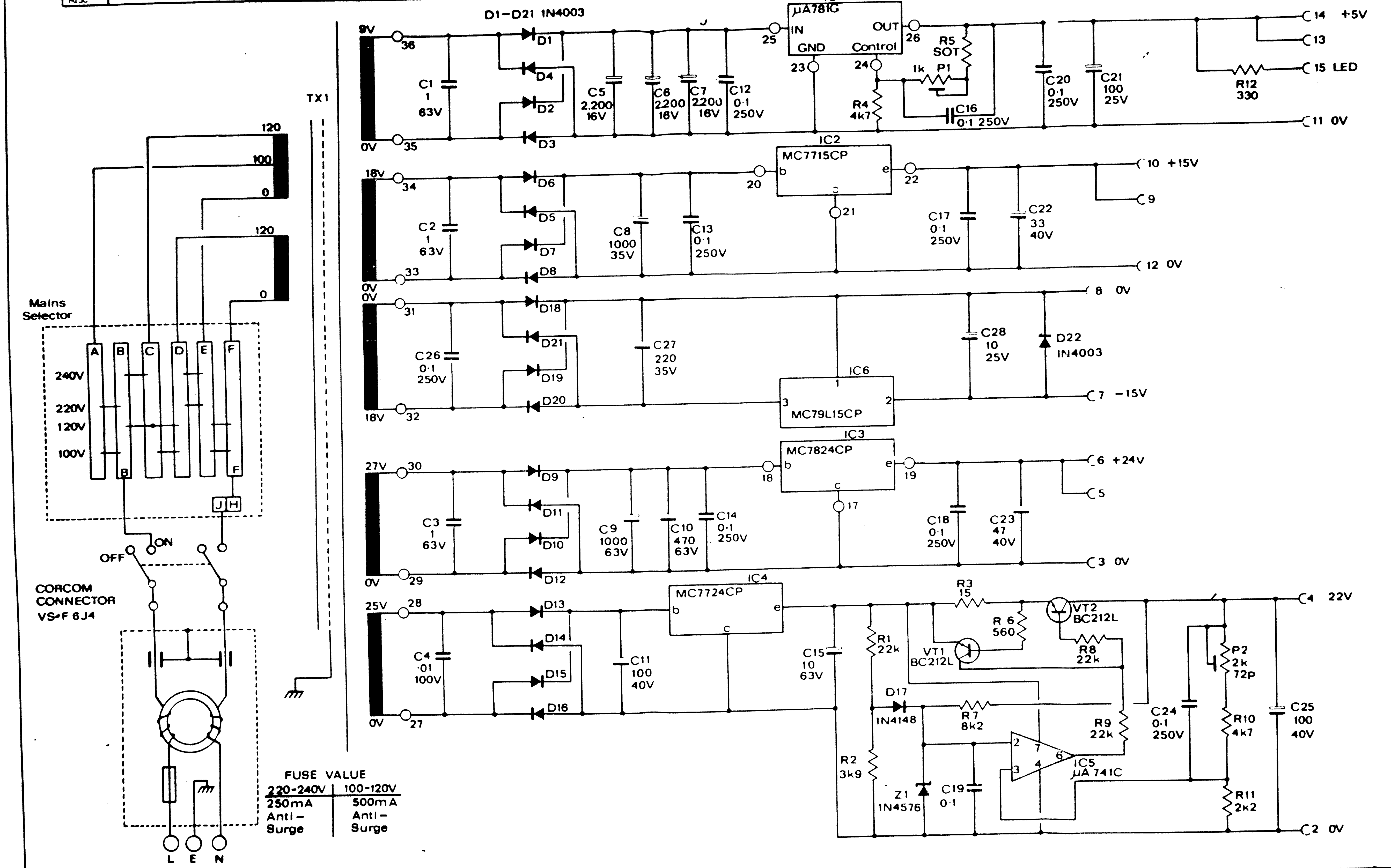
TITLE
POWER SUPPLY BOARD
WIRING SSG 520

DRAWING NO
3ZV0832280

SHEET OF SHEETS

DRAWING No 2ZX0832168

R	1,2,28,3,4 · 11,5,9,8,6,10, · 7,13,14,12, · 15 · 12 4 · 16 · 17, 19, 28, 23, 22, 20, 21, · 7,3, · 6 · 8 · 9 · 24 · 10,11,12 · 25
C	1 · 2
VT	TX1 · D1–21 · IC4 · IC2,6,3,1, · D17 · Z1 · P1 · IC5 · P2
MISC	



TRACED				
CHECKED	C	14.4.78	P 4642	
	B	16.12.77	Q 4456p	
DRAWN J N	ISS	DATE	MOD No	
	A	10.10.77		

All Resistor values in ohms(Ω) unless otherwise stated
" Capacitor " " μf " " "

TOLERANCES · MATERIAL · SCALE · PROTECTIVE FINISH · DIMENSIONS IN MM · NOTE

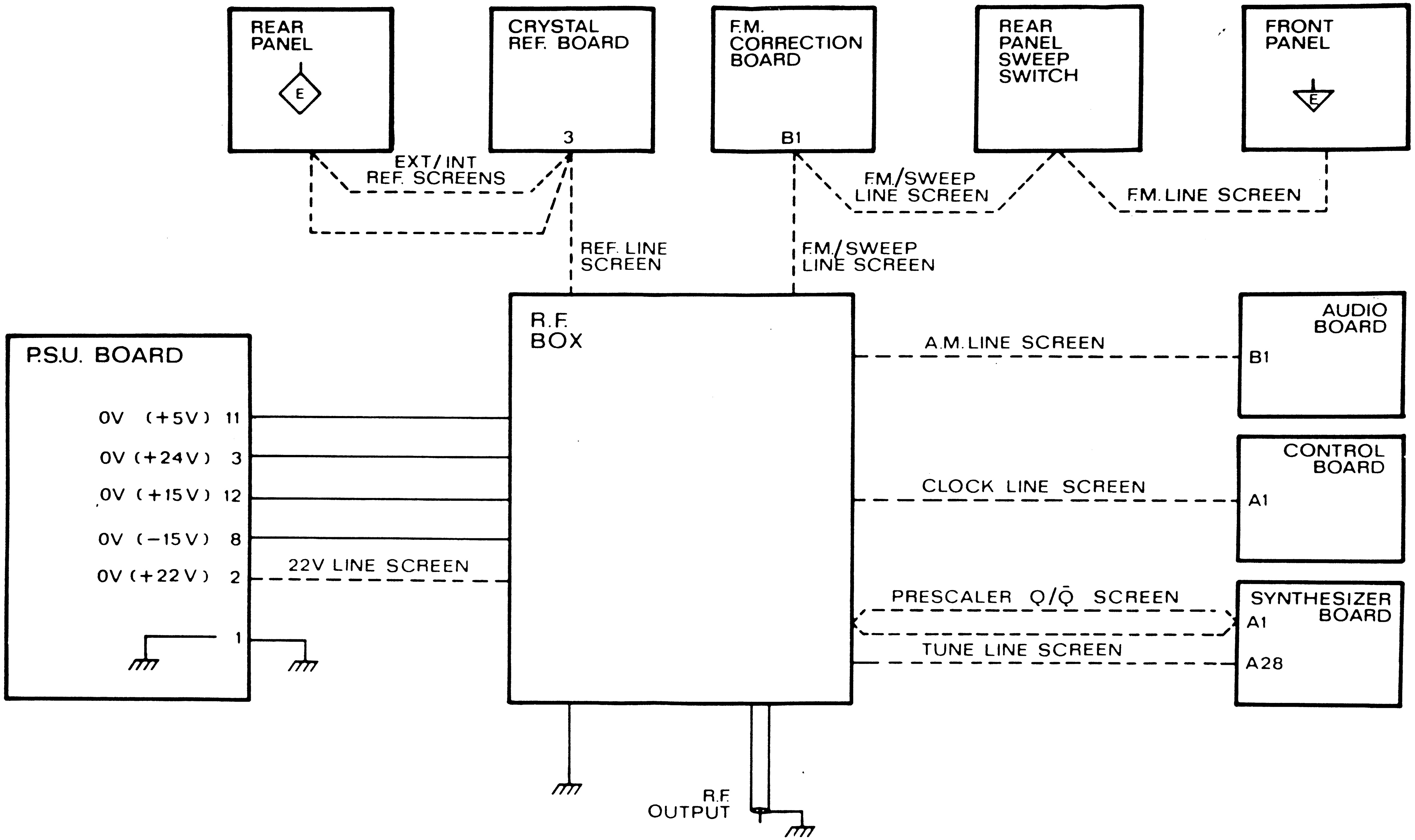
Section 15 mue1 11·78

TITLE SSG520 POWER SUPPLY CIRCUIT DIAGRAM

DRAWING No 2ZX0832168

SHEET OF SHEETS

DRAWING NO.
3ZV0832281



TRACED						USED ON	
CHECKED							
DRAWN	ISS	DATE	MOD. NO				
	A	3.5.78					

FARNELL INSTRUMENTS LTD. WETHERBY.

TITLE
EARTH RETURNS
SSG 520 *Section 15 issue 1 11·78*

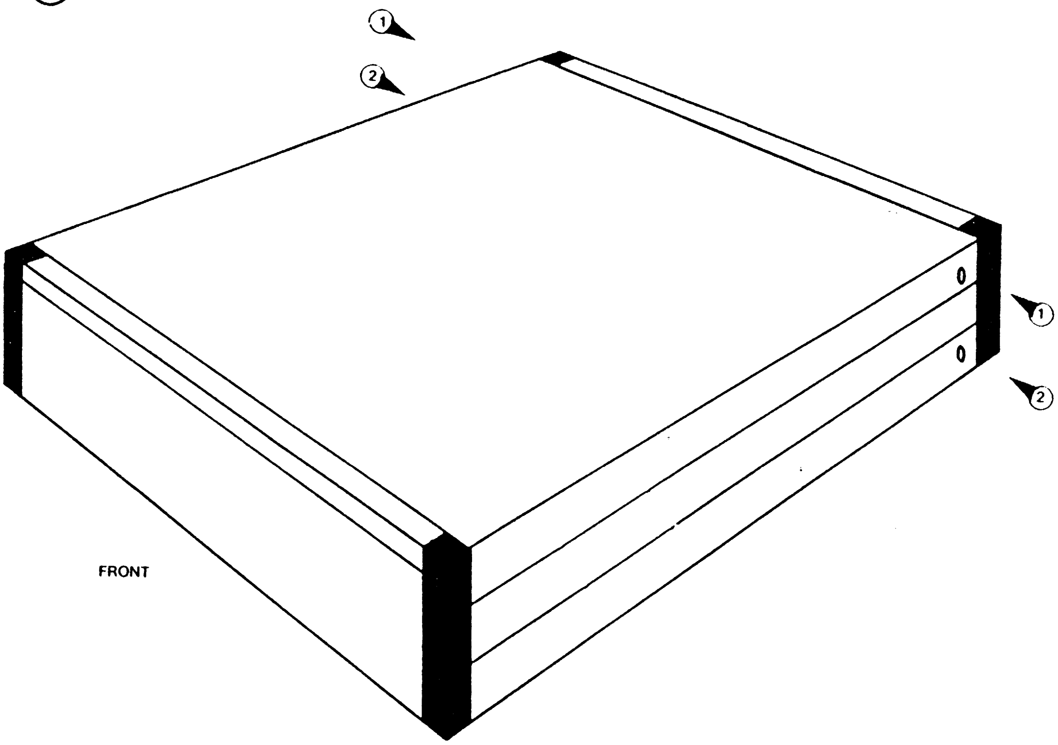
DRAWING NO.
3ZV0832281

SHEET OF SHEETS

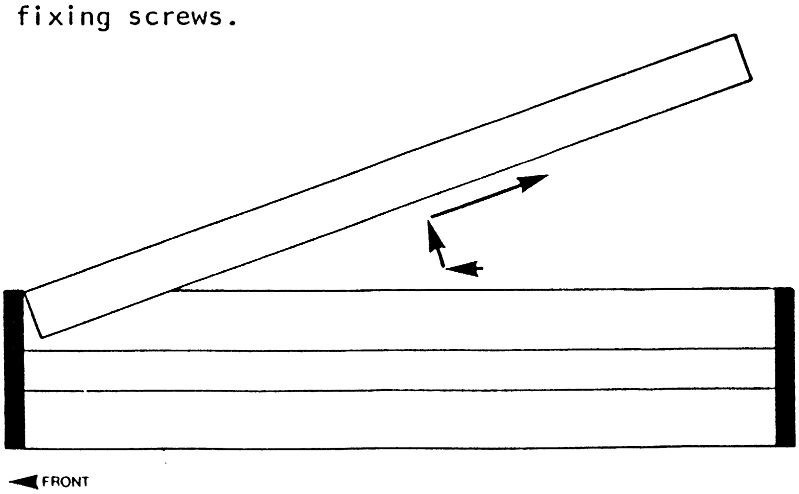
INSTRUMENT DISMANTLING FOR CALIBRATION OR REPAIR

1. *Removal of top and bottom lids*

With instrument in normal operating position remove the two small screws in the sides of the upper lid near the back of the instrument (1). Slide the lid towards the front panel slightly so that the rear edge of the lid clears the locating grooves. Lift the lid off the instrument, rear edge first. Turn the instrument over and repeat the above with the lower lid and lower screws (2).

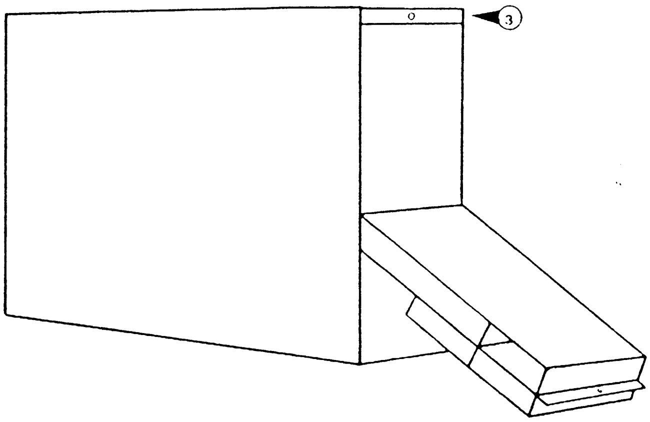


To replace the lids, fit the front edge into the locating grooves behind the front panel whilst holding the lid at an angle with the rear edge clear of the frame. The lid can then be lowered on to the frame. Slide the lid towards the back panel slightly to engage the retaining grooves there and fit the two fixing screws.

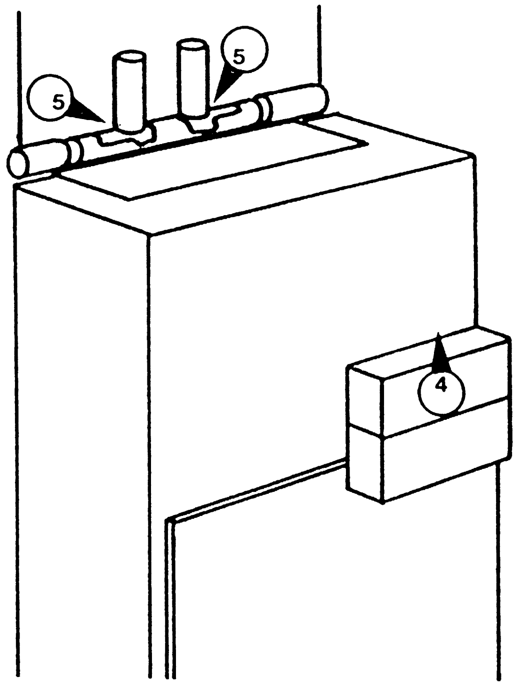


2. *Power supply removal*

Stand the instrument on the left hand side (as viewed from the front). Release the quarter-turn fastener retaining the power supply at the edge of the back panel (3). Gently lower the power unit around the hinge until it rests on the work surface. The power supply can be left in this position if the instrument is to be operated during calibration/repair, or it can be removed completely.



Release the two spring clips retaining the plug to the power supply circuit board and pull off the plug (4). Slide the two spring-loaded hinge pins on the power supply hinge inwards and rotate them through 90° to retain them in this position (5). The power unit can now be removed from the main frame.

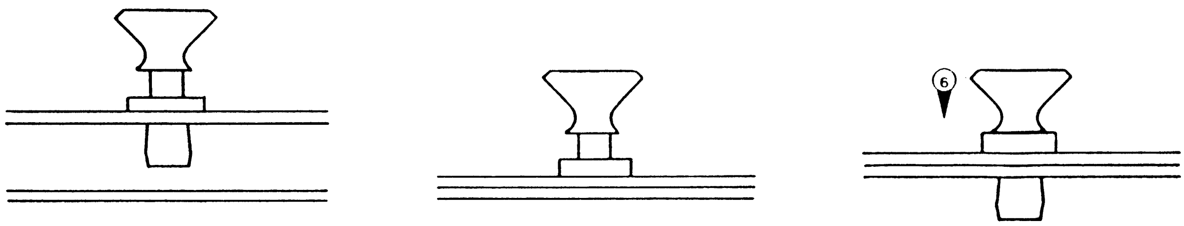


When re-assembling ensure the hinge pins are fully relocated in the hinge assembly and that the power supply board plug retaining clips are secure.

3. *Plug-in circuit board access*

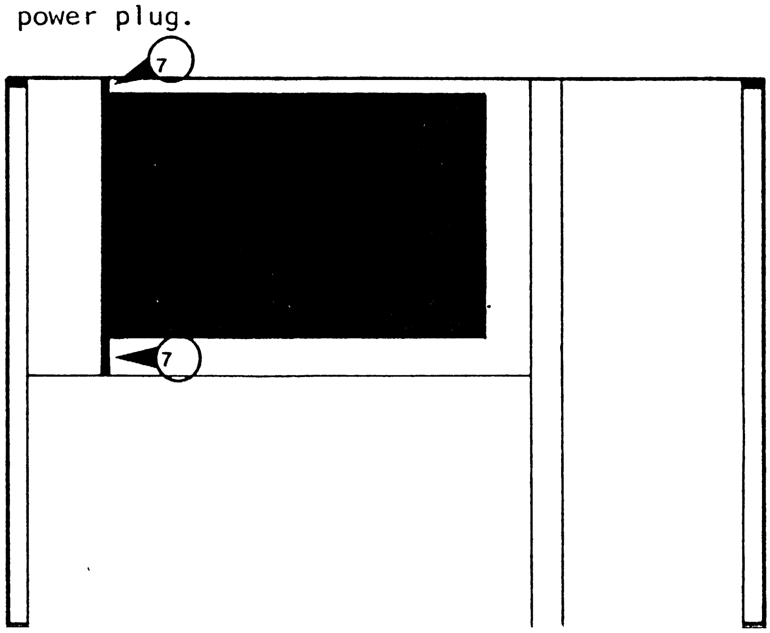
The four large circuit boards (range control, synthesizer, f.m. correction and audio/SINAD) are all plugged into hinged sockets. At the other edge the boards are retained by plastic push-pull fasteners. With the instrument on its side, all four boards can be hinged out simultaneously at right angles to the chassis. To release the board pull on the black plastic fastener.

When replacing ensure the circuit board is correctly positioned and the plastic fastener body fully seated in the chassis before pushing in the plunger to lock the fixing (6).



4. *R.F. box cover withdrawal*

Access to the r.f. enclosure is obtained by releasing the four corner quarter-turn fasteners (7). The cover may then be pulled along the guide bars and through the hole in the rear panel using the handle fixed to the end of the cover. Be careful when sliding the lid that it does not touch any components or wires inside the r.f. enclosure. When the lid is fully withdrawn it covers the mains switch on the power supply, so if the unit is to be operated with the r.f. lid withdrawn, leave the switch on and switch the unit at the main power plug.



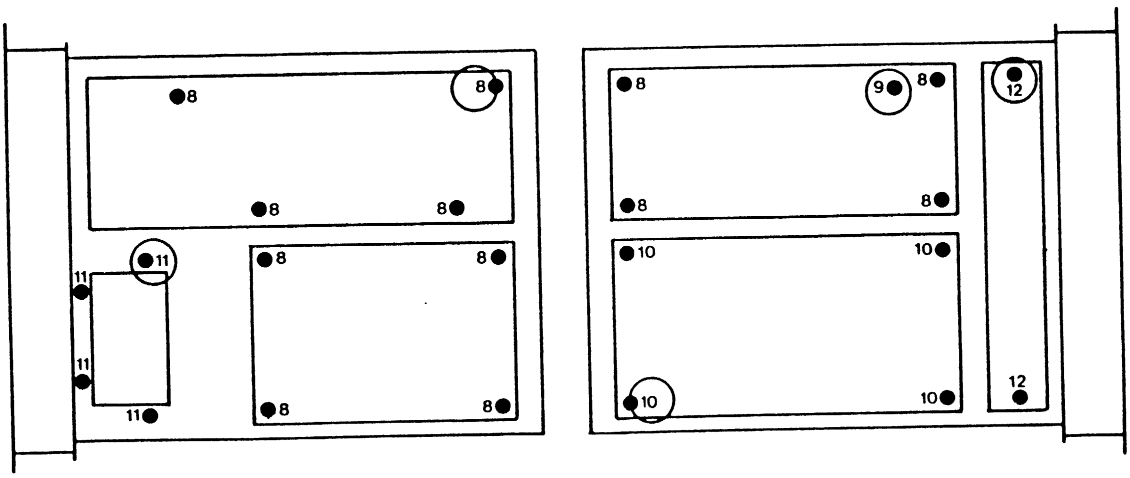
With the unit on its side the r.f. lid can be locked out by easing the heads of the quarter-turn fasteners through the chassis holes provided thus holding the lid away from the r.f. box components. When working in the enclosure be careful not to damage the two metal mesh r.f. gaskets and their mating surfaces.

5. *Operation of the unit with mains power applied*

At all times be wary of causing short circuits with any metal tools. Beyond this dismantling of the unit to this stage involves no special precautions to safeguard the operation or instrument because all dangerous voltages are contained in the totally enclosed power supply section. The instrument can therefore be operated and serviced with complete safety. Provided the power supply main section is not opened further dismantling can still be performed with complete operator safety, but special care must be exercised when removing screwed-in circuit boards and components. This particularly applies to the wiring connections if the power is applied and the unit operating, because short circuits could occur and circuit damage result.

6. *Removal of the r.f. enclosure boards*

With the unit placed on its left hand side, the looms to the four circuit boards in the r.f. enclosure are arranged to run along the lower edges, so after the board fixing screws have been removed (8) the boards can be hinged downwards for access to the back. Take care when the instrument is switched on that the wiring, tracks and components do not inadvertently touch each other or the chassis.



The output amplifier board can only be removed after the solid output coaxitube has been removed (9). Lift the resistor off the coax inner conductor and, with care, completely unsolder the coax outer conductor on the circuit board. The board can then be slid off the output coaxitube. When replacing, the coaxial outer conductor must be soldered all the way round where it meets the board. This ensures continuous earth contact.

The prescaler circuit board has a metal shield fitted over it and this must be removed for access (10). Some of the metal shields are tack-soldered to improve their effectiveness. These joints must be broken to remove the shield and remade in the same place when re-assembling.

A stripline oscillator can be removed for access to the components under the tuned lines by removing the four nuts fixing the assembly to the r.f. box centre plate (11).

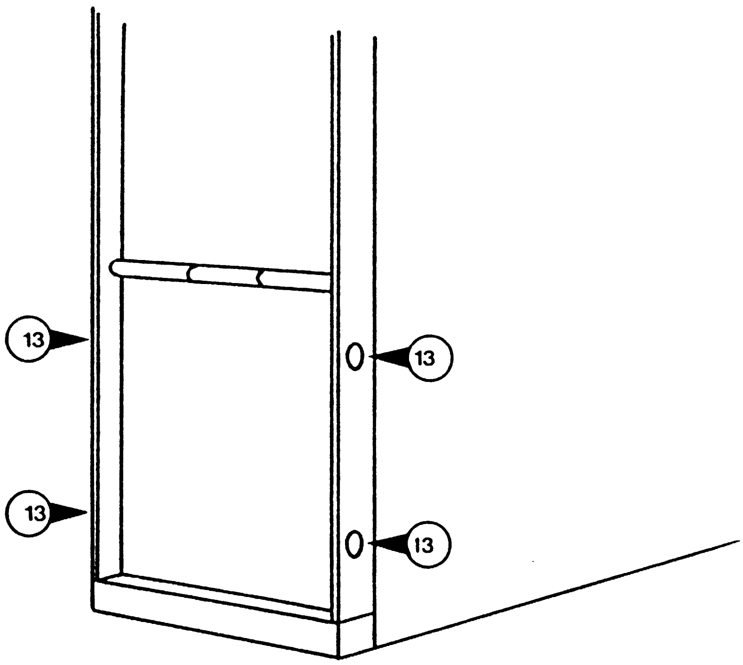
7. *Output attenuator removal*

After removing the output amplifier from the attenuator input coaxitube, remove the attenuator output coaxitube from the connector on the r.f. box and then remove the two attenuator fixing nuts (12). Access to the attenuator relays is obtained by unscrewing the appropriate locking ring on the back of the attenuator assembly. The relays can be withdrawn out of the back of the assembly after unsoldering the r.f. connections inside the attenuator. The two 40dB attenuator sections have metal foil covers soldered over them to isolate them from the r.f. radiation inside the r.f. box. These covers must be removed before access can be obtained to the 40dB sections. When replacing the foil (preferably with new material) ensure a continuous soldered joint all the way round using the minimum of heat.

When components are replaced inside the attenuator ensure they are positioned exactly where the old components were and with the same lead lengths.

8. Rear panel removal

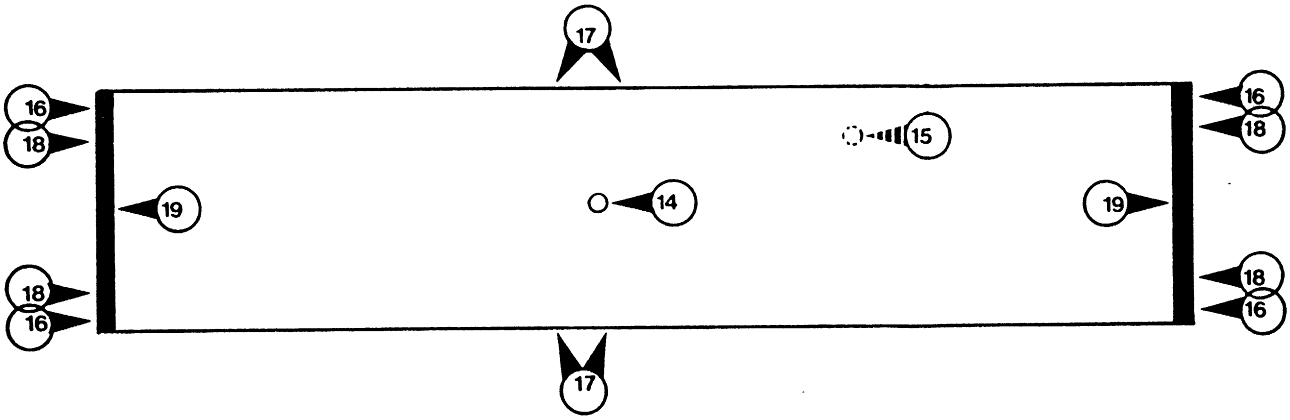
The small fixed portion of the rear panel must be removed for access to the crystal reference oscillator board. Remove the power supply completely and remove the four screws fixing the rear panel to the top and bottom rear chassis bars (13). The panel may then be eased away from the chassis and hinged round on the wiring loom. In this position the power unit may be refixed if instrument operation is required. The crystal reference board is retained by four screws.



9. *Front panel removal*

Remove the mains push knob. Access to the collet fixing is obtained after pulling off the knob cap (14) . Remove the spring behind the knob. Remove the power supply assembly and slide the mains push rod out of the back of the instrument. Disconnect the r.f. connector from the front of the r.f. box (15) . Remove the two front panel side mouldings (16) . Remove the four screws holding the two gusset plates to the centre of the front panel (17) . Turn the instrument upside down and remove the four screws holding the front panel to the chassis side plates (18) . The two small aluminium filler extrusions at each side of the front panel will be released at this stage (19) . The front panel can now be pivoted downwards on the looming for access to the front panel components and wiring.

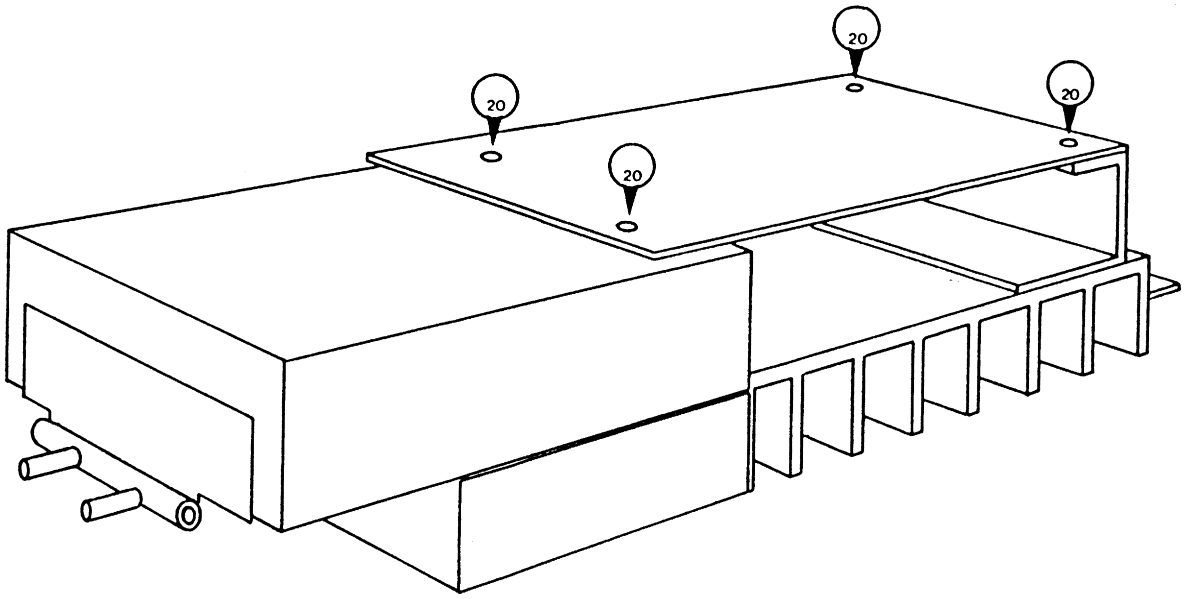
When replacing the mains push rod ensure the anti-rotation bolt at the back of the rod is passed through the hole provided in the chassis.



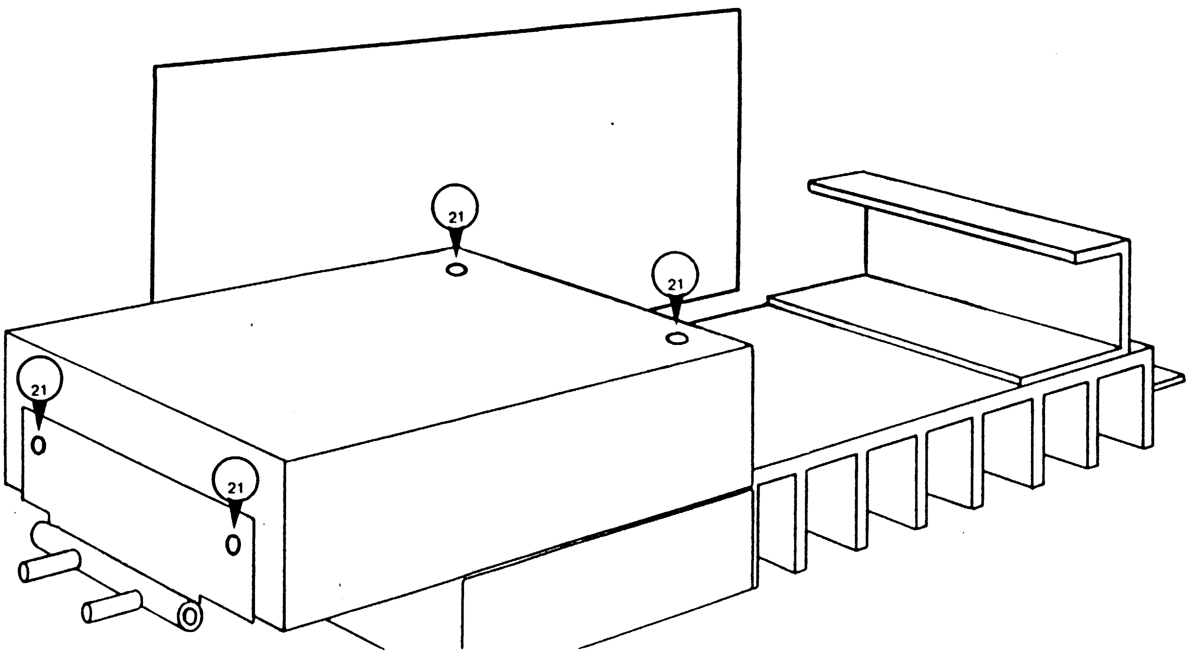
10. *Power supply dismantling*

WARNING - The power unit contains hazardous voltages when connected to a power source.

The circuit board may be detached by removing the two screws and two nuts retaining it (20). The board may then be pivoted over to gain access to the reverse side and to the regulators on the heatsink. This may be done with the unit operating.

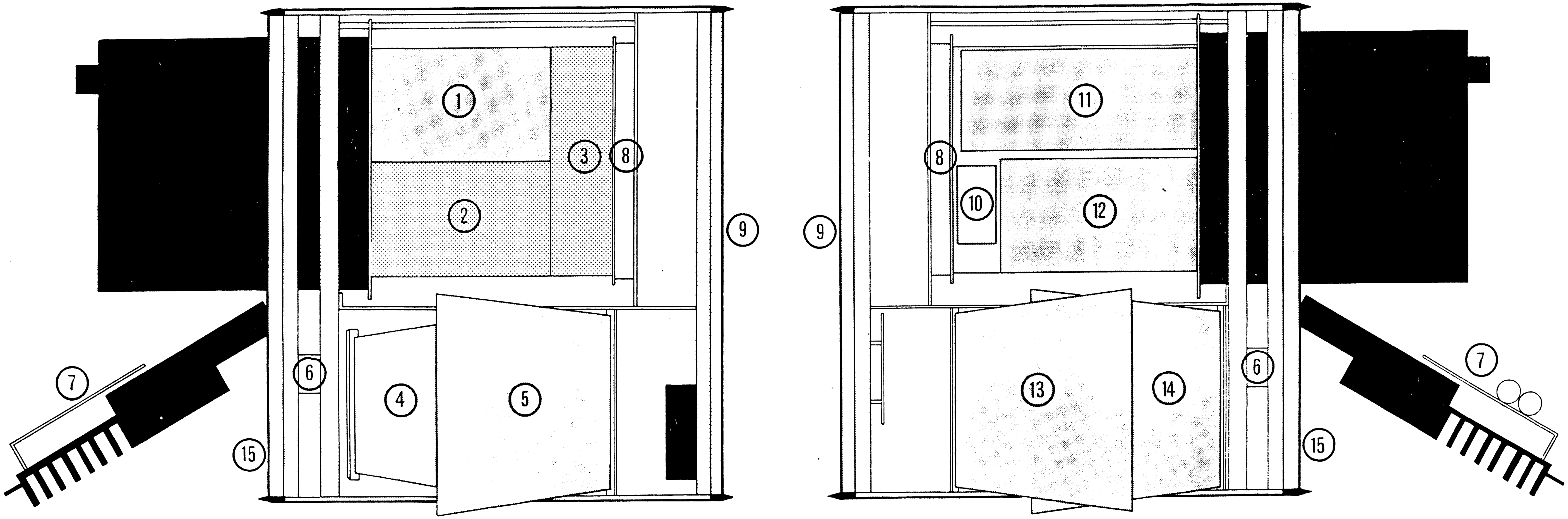


To gain access to the mains switch, fuse, selector and transformer, first remove the mains power cord to ensure no dangerous voltages exist. Then remove the four screws (21) and separate the two halves of the power unit mains section.



SSG 520

Location of circuit boards



1. AMPLITUDE MODULATOR AND A.L.C. OUTPUT AMPLIFIER
2. PRESCALER AND PRESCALER BUFFER AMPLIFIER
3. OUTPUT ATTENUATOR
4. F.M. CORRECTION BOARD
5. SYNTHESIZER BOARD
6. CRYSTAL REFERENCE BOARD
7. POWER SUPPLY BOARD
8. R.F. BOX
9. FRONT PANEL
10. STRIPLINE R.F. OSCILLATOR
11. FIRST A.L.C. AMPLIFIER AND RANGE DECODER
12. R.F. OSCILLATOR BOARD
13. RANGE CONTROL AND OUTPUT LEVEL BOARD
14. AUDIO AND SINAD BOARD
15. REAR PANEL

ROUTINE RECALIBRATION

1. VOLTAGE RAILS

Power supply board (No. 2ZX0832168)

(i) Monitor the 5V supply across C21 with a DVM and adjust P1 to give an output when fully loaded of 5.2V ±20mV.

(ii) Monitor the 22V supply across C25 with a DVM and adjust P2 to give an output of 22V ±30mV.

2. FIRST A.L.C. AMPLIFIER OUTPUT

Range decoder buffer amp. board (No. 2ZX832169)

(i) Disconnect the r.f. cables from the amplifier output and monitor the output level with a 50Ω r.f. power meter.

(ii) Set the r.f. to 10MHz.

(iii) Adjust P1 to give an output level of +3dBm.

3. PRESCALER BUFFER AMPLIFIER OUTPUT

Prescaler buffer amp. board (No. 2ZX0832162)

(i) Break link between amplifier output and prescaler.

(ii) Set the r.f. to 500MHz.

(iii) Adjust P1 to give an output level of 0dBm.

4. OUTPUT LEVEL

Range control board (No. 3ZX0832165 sheet 2)

(i) Monitor r.f. output on front panel with 50Ω r.f. power meter. Set to 100MHz.

(ii) Set P2 fully c.w.

(iii) Adjust the 'set level' front panel control to centre position. White line on knob should be in 2 o'clock position with potentiometer in centre of mechanical rotation range. Reset control so white line is in 12 o'clock position. (This operation gives more resolution on levels above 0dBm than below).

(iv) Adjust P1 until the r.f. output is 0dBm.

(v) Adjust P3 until the edge meter on front panel reads centre scale.

5. 1dB STEPS

Range control board (No. 3ZX0832165 sheet 2)

(i) Monitor r.f. output with 50Ω power meter. Ensure a.m. is not being applied.

(ii) Set output frequency to 10MHz. Check the output level is 0dBm with attenuator set to zero - see 5.

(iii) Select -9dBm on attenuator.

(iv) Adjust P4 until output is -9dBm.

6. AUDIO OUTPUT LEVEL

Sinad board (No. 2ZX0832166 sheet 1)

(i) Monitor internal oscillator output on front panel with oscilloscope or a.f. voltmeter.

(ii) Set P7 to give a 1V r.m.s. output.

7. AMPLITUDE MODULATION

Amplitude modulator output amp. board (No. 2ZX0832161)

(i) Set audio output level - see 6 above

(ii) Set output frequency to 100MHz. Using modulation meter set modulation to 100% a.m. at 1kHz.

(iii) Monitor demodulated a.f. output of modulation meter with an oscilloscope and adjust P2 until envelope peaks are just flattening.

(iv) Set to 30% a.m. and monitor demodulated a.f. from modulation meter with a distortion analyser.

(v) Set P1 for minimum distortion.

Audio board (No. 2ZX0832166 *sheet* 2)

(vi) Monitor a.m. depth with a modulation meter and set 50%.

(vii) Set P6 so front panel meter calibration is correct.

8. FREQUENCY MODULATION

F.M. *correction board* (No. 1ZX0832167)

(i) Set audio output level - see 6 above

(ii) Set r.f. output to 100MHz.

(iii) Monitor wiper of front panel f.m. level control with an oscilloscope.

(iv) Adjust f.m. level control until oscilloscope shows 10V peak to peak.

(v) Monitor r.f. output with modulation meter. Set P1 to give a deviation of 100kHz.

Audio board

(vi) Adjust P8 to calibrate front panel meter.

F.M. *correction board*

(vii) Set f.m. range switch to 3kHz and adjust level control to read 3kHz on front panel meter.

(viii) Adjust P2 to give a true deviation of 3kHz.

9. SINAD

Sinad board (No. 2ZX0832166 *sheet* 1)

(i) Connect the 1kHz audio output on front panel to the SINAD output.

(ii) Monitor test point 2 with an oscilloscope and adjust P1 and P2 to give minimum 1kHz component. The presets will have to be adjusted alternately.

(iii) Inject a known 25% distorted signal into the SINAD output and tune its frequency around 1kHz so SINAD reading is minimised. (An over-ranged modulation meter a.f. output can be used as a source of pre-distorted 1kHz).

(iv) Adjust P5 to calibrate meter reading to 12dB SINAD.

RANGE CHANGE POINTS

Range control board (No. 3ZX0832165 sheet 1)

Ranges can be held by switching SW1 on control board from 'auto' to 'manual' and setting the control switches to the binary values shown below.

Range number	Frequency range	Switch setting A	B	C	D
1	10.0000 - 13.9999MHz	1	0	0	0
2	14.0000 - 21.9999	0	1	0	0
3	22.0000 - 31.9999	1	1	0	0
4	32.0000 - 43.9999	0	0	1	0
5	44.0000 - 61.9999	1	0	1	0
6	62.0000-85.9999	0	1	1	0
7	86.0000-123.9999	1	1	1	0
8	124.0000-175.9999	0	0	0	1
9	176.0000-253.9999	1	0	0	1
10	254.0000-361.9999	0	1	0	1
11	362.0000-520.9999	1	1	0	1

RECALIBRATION OF FREQUENCY

Adjusting the internal crystal reference

Note: *This adjustment should not be attempted without a suitable frequency standard.*

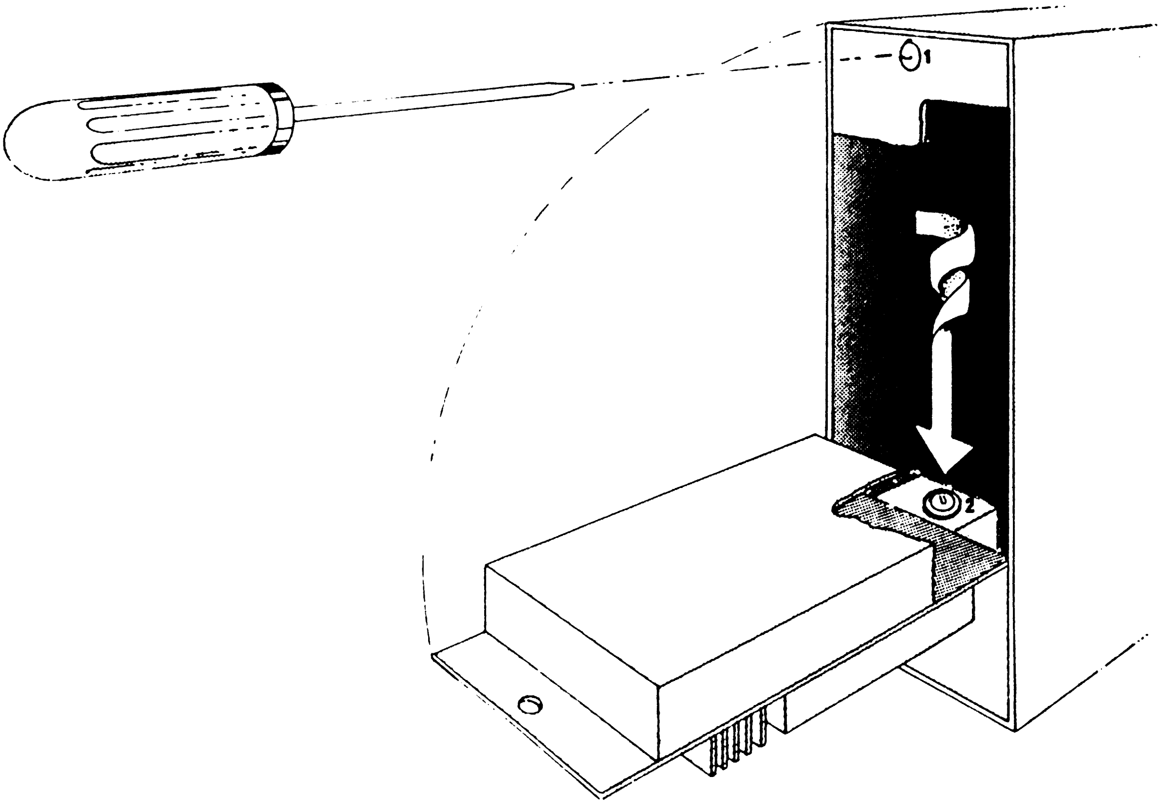
Stand the instrument up on the left hand side (viewed from the front). Turn the quick release (1) at the end of the PSU assembly on rear panel by half a turn. Gently lower PSU assembly down on the hinge.

Standard crystal reference

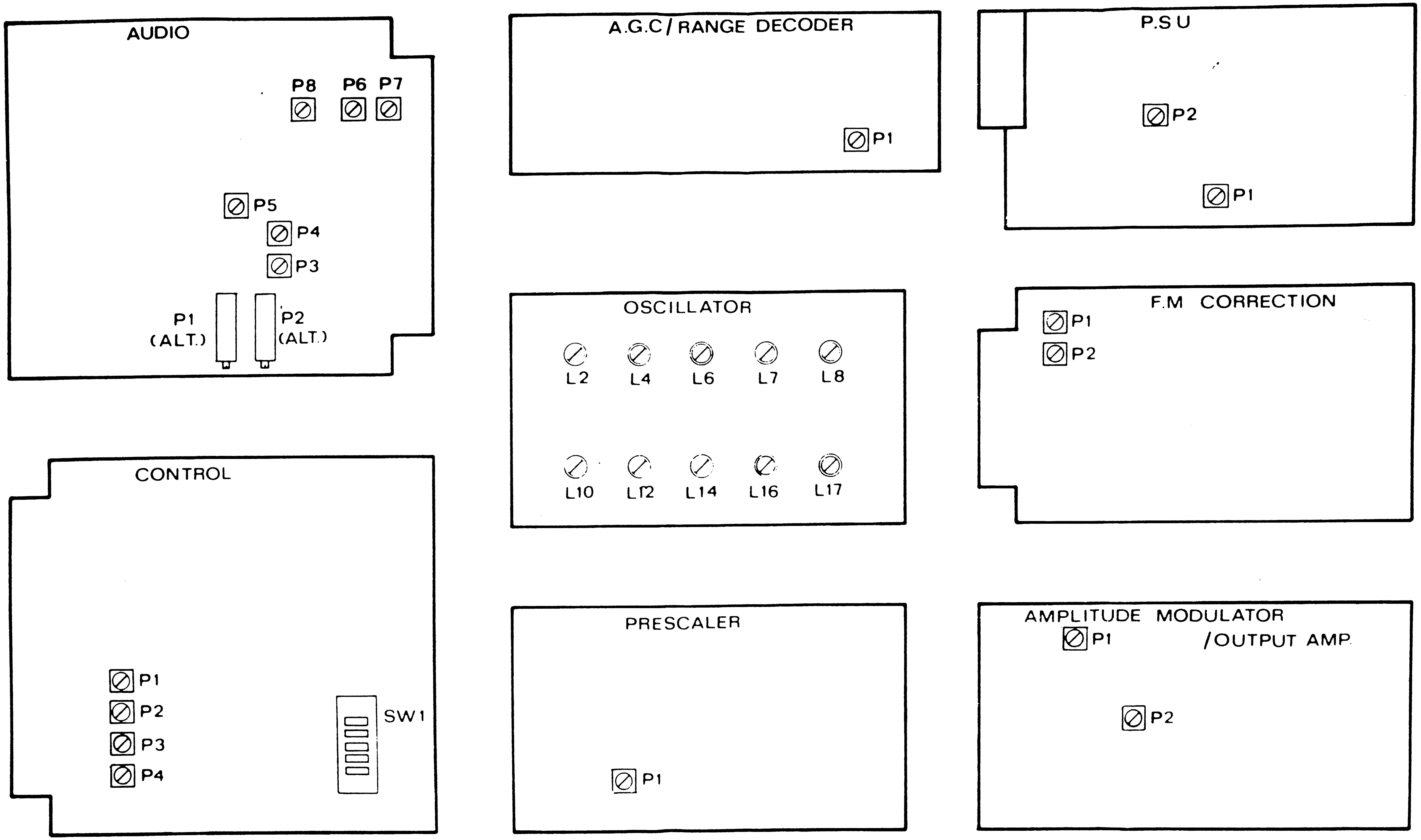
Using an appropriate small screwdriver (preferably non-metallic) adjust the crystal frequency control (2) whilst monitoring either the synthesizer output or the crystal reference output with a suitable frequency standard. The reading should correspond either to the thumbwheel settings (synthesizer output) or the crystal reference output specified at the rear panel socket, respectively.

Option A units

Option A units are fitted with separate coarse (capacitor) and fine (potentiometer) adjustments (2) and (3) respectively. Using a small screwdriver, adjust the multi-turn potentiometer (3) whilst monitoring against an external frequency standard as above. If the potentiometer runs out of range then reset it to the mid-point of its track and remove the dust plug from the oven unit (2). Use a small screwdriver (preferably non-metallic) to adjust the coarse frequency control (2) as above. Replace the dust plug and fine tune (3).



DRAWING No 3ZV0832276



TRACED						NOTES
CHECKED	GW					
DRAWN	J.N.	ISS	DATE	MOD No		
		A	19.6.78	—		

FARNELL INSTRUMENS LTD. WETHERBY, YORKS

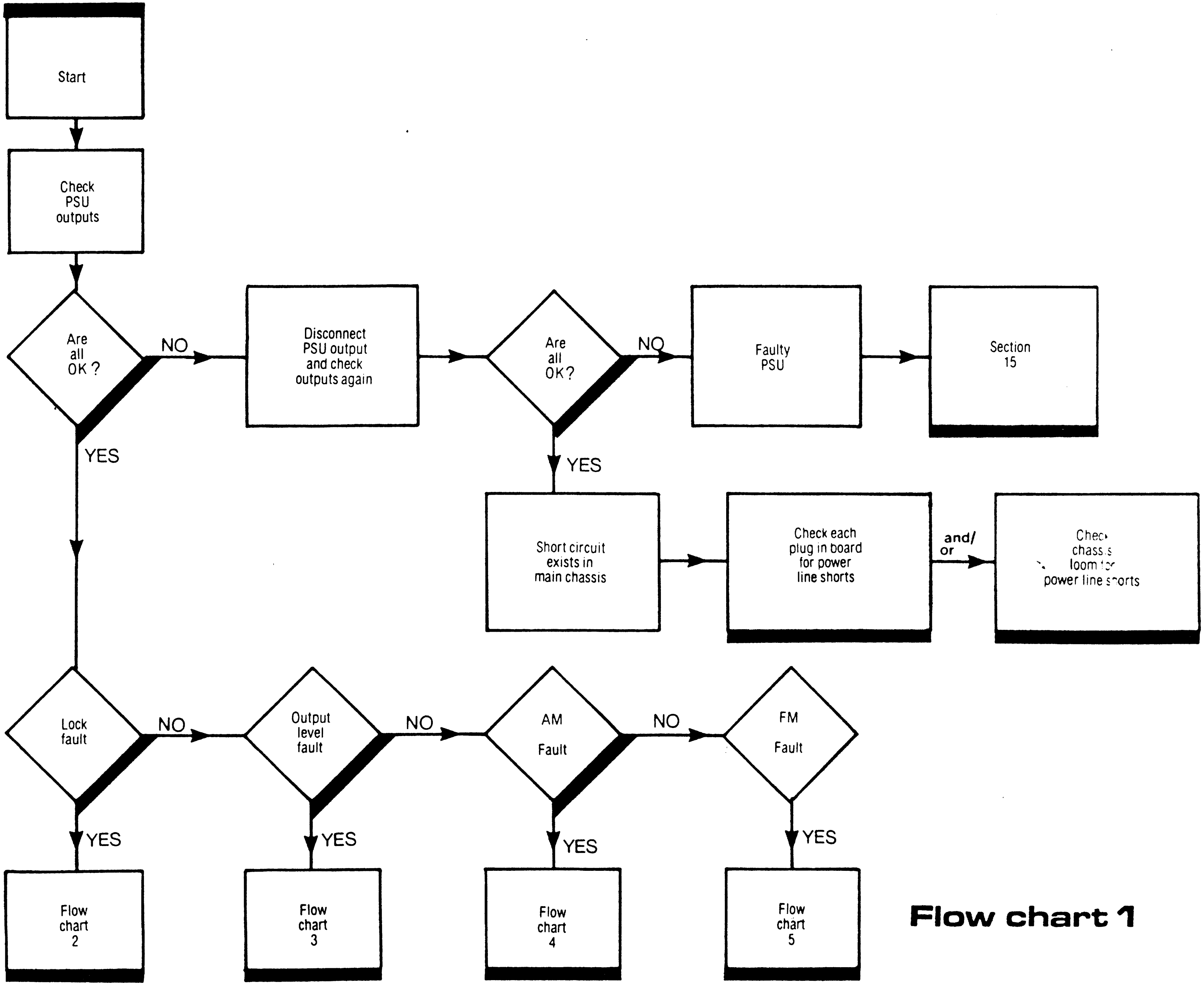
CALIBRATION POINTS

SSG520

DRAWING No

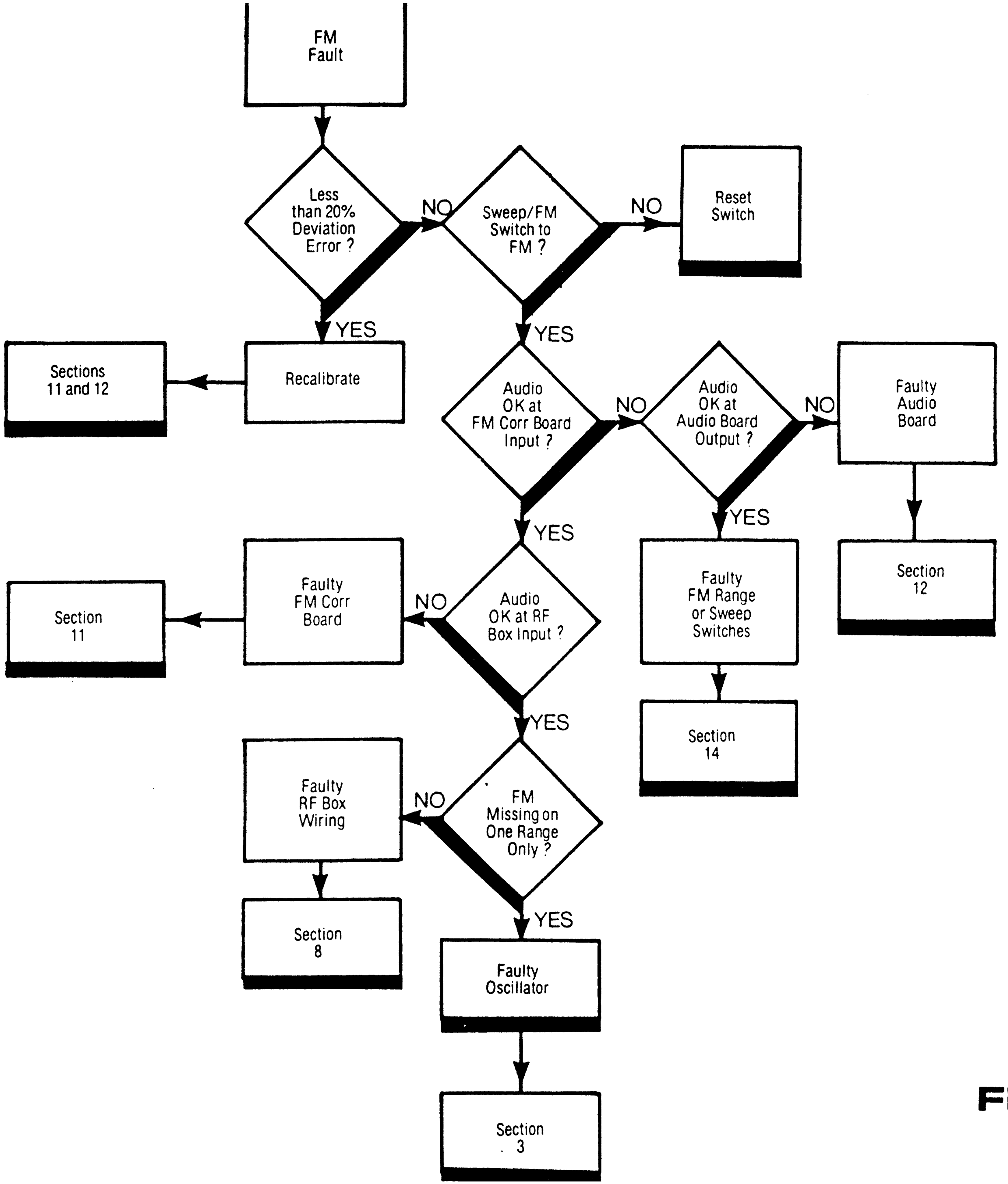
3ZV0832276

Section 17 issue 1 11·78



Start
Check PSU outputs
Are all OK ?
NO
YES
Disconnect PSU output and check outputs again
Are all OK?
NO
YES
Faulty PSU
Section 15
Short circuit exists in main chassis
Check each plug in board for power line shorts
and/or
power line shorts
Lock fault
NO
YES
Output level fault
NO
YES
AM Fault
NO
YES
FM Fault
YES
Flow chart 2
Flow chart 3
Flow chart 4
Flow chart 5

Flow chart 1


FM Fault
Less than 20% Deviation Error ?
YES
Recalibrate
Sections 11 and 12
NO
Sweep/FM Switch to FM ?
NO
Reset Switch
YES
Audio OK at FM Corr Board Input ?
NO
Audio OK at Audio Board Output ?
NO
Faulty Audio Board
Section 12
YES
Faulty FM Range or Sweep Switches
Section 14
YES
Audio OK at RF Box Input ?
NO
Faulty FM Corr Board
Section 11
YES
FM Missing on One Range Only ?
NO
Faulty RF Box Wiring
Section 8
YES
Faulty Oscillator
Section 3

Flow chart 5

Remote programming (Option B)

A 50 way rear panel socket enables remote control of the output frequency, attenuation, modulation on/off and SINAD meter reading. The frequency steps 10kHz to 100MHz are CMOS level, the 100Hz and 1kHz steps being ECL. 10dB steps are selected by driving with +24V and the 1dB steps resistor programmed.

A.M. and/or f.m. can be selected by a contact closure to a common line and the SINAD meter output is available as an analogue level. Other outputs are the r.f. lock indication, underrange and overrange, and the SINAD input a.g.c. within-range indication.

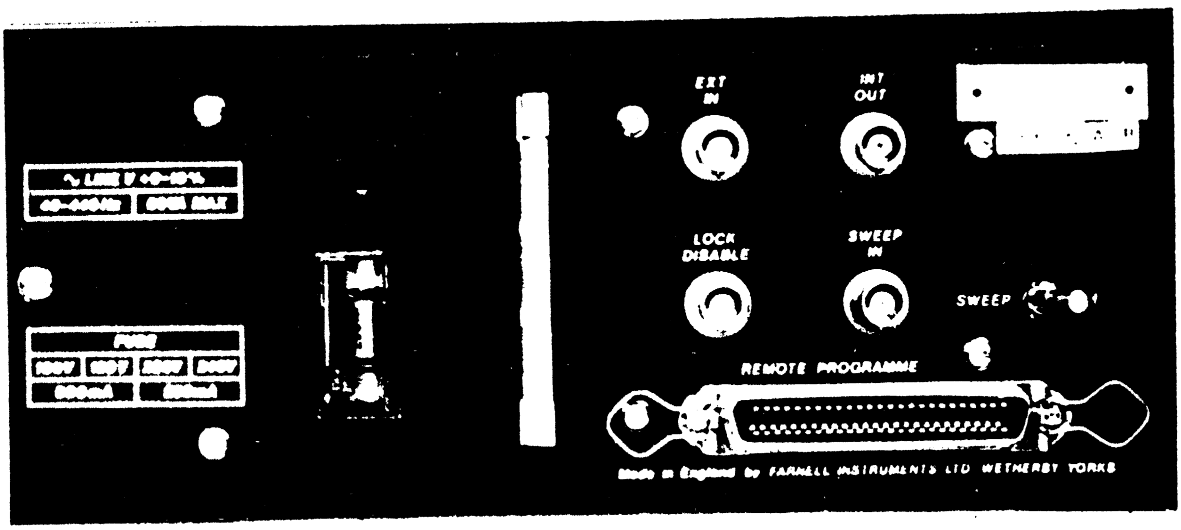
Voltages of +5, $\pm$ 15 and +24 are also available for programme use. These supplies must not be used to drive external circuits.

Before programming, ensure that the thumbwheel switches and attenuator step-switches are all set to zero. Also that the two modulation internal/external select switches on front panel are set to the central off position after setting up the required modulation depth/deviation.

Under no circumstances must voltage levels exceeding those specified be applied. Internal circuit damage may result.

Changing frequency remotely will not instigate an f.m. calibration. This can be done at any time after a new frequency has been demanded.

Apart from automatic test routines originated by computers/calculators, the programme facility of the SSG520 enables the hard-wiring of regularly used frequency channels and mute/squelch levels to a multi-switch, thus giving very convenient resetting of these parameters.



Programme socket identification

LEVEL	FUNCTION	PIN No		FUNCTION	LEVEL
	Mod select common	1	26	SINAD AGC in	+15V = AGC in
0 to 1V approx.	SINAD meter reading	2	27	N.C.	
+15V = out of lock	Lock indication	3	28	F.M.	Cal CMOS. OV = Cal
Short to pin 1	AM select	4	29	FM select	Short to pin 1
+15V = u/r	Underrange	5	30	Overrange	+15V = o/r
	N.C.	6	31	-15V	
	+5V	7	32	OV	
	+24V	8	33	+15V	
ECL + 5V = '1'	'2' 100'sHz	9	34	100'sHz '1'	ECL + 5V = '1'
"	'4' 100'sHz	10	35	100'sHz '8'	"
"	'2' kHz	11	36	kHz '1'	"
"	'4' kHz	12	37	kHz '8'	"
CMOS +15V = '1'	'2' 10'skHz	13	38	10'skHz '1'	CMOS +15V = '1'
"	'4' 10'skHz	14	39	10'skHz '8'	"
"	'2' 100'skHz	15	40	100'skHz '1'	"
"	'4' 100'skHz	16	41	100'skHz '8'	"
"	'2' MHz	17	42	MHz '1'	"
"	'4' MHz	18	43	MHz '8'	"
"	'2' 10'sMHz	19	44	10'sMHz '1'	"
"	'4' 10'sMHz	20	45	10'sMHz '8'	"
"	'2' 100'sMHz	21	46	100'sMHz '1'	"
"	'4' 100'sMHz	22	47	N.C.	
Resistor programme to pin 48	1dB	23	48	1dB	Resistor programme to pin 23
Take to +24V	'2' 10dB	24	49	10dB '1'	Take to +24V
"	'4' 10dB	25	50	10dB '8'	"

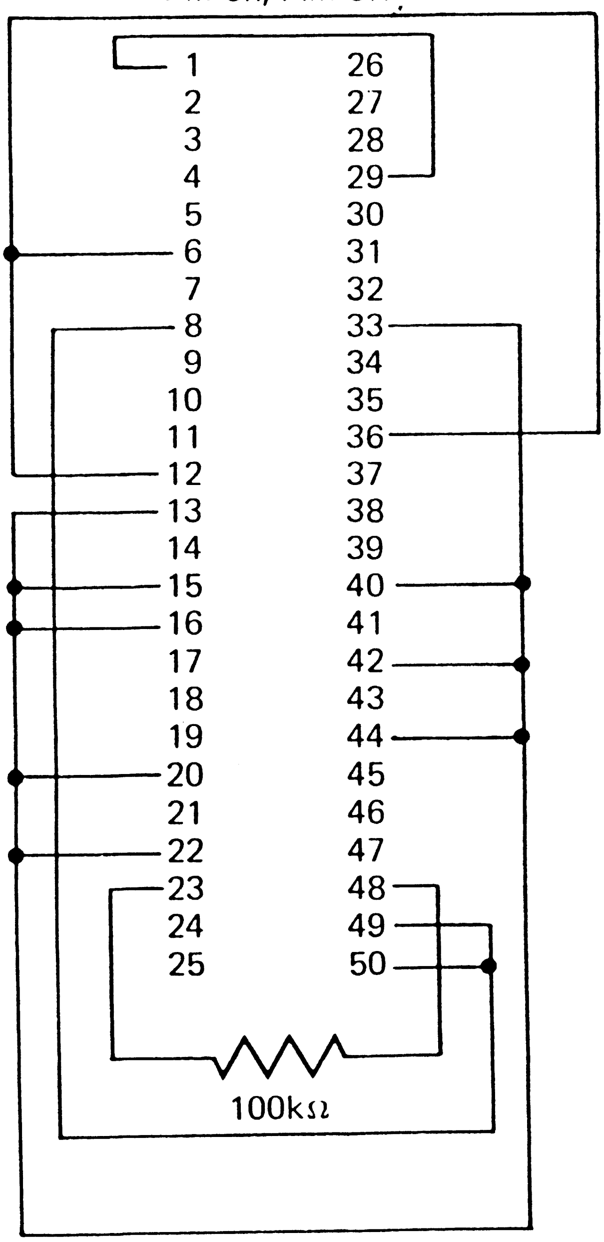
Programme plug type Amphenol 57 30500 50 way

1dB attenuator programme resistors

dB	Required resistance	Convenient standard values
1	820k	820k
2	386k	470k/2M2
3	242k	270k/2M7
4	171k	220k/820k
5	128k	150k/1M
6	100k	100k
7	80.8k	82k
8	66.2k	68k
9	55k	56k

Programme example

Frequency	451.7250 MHz
Output level	−96dBm
Modulation	FM-on, AM-off

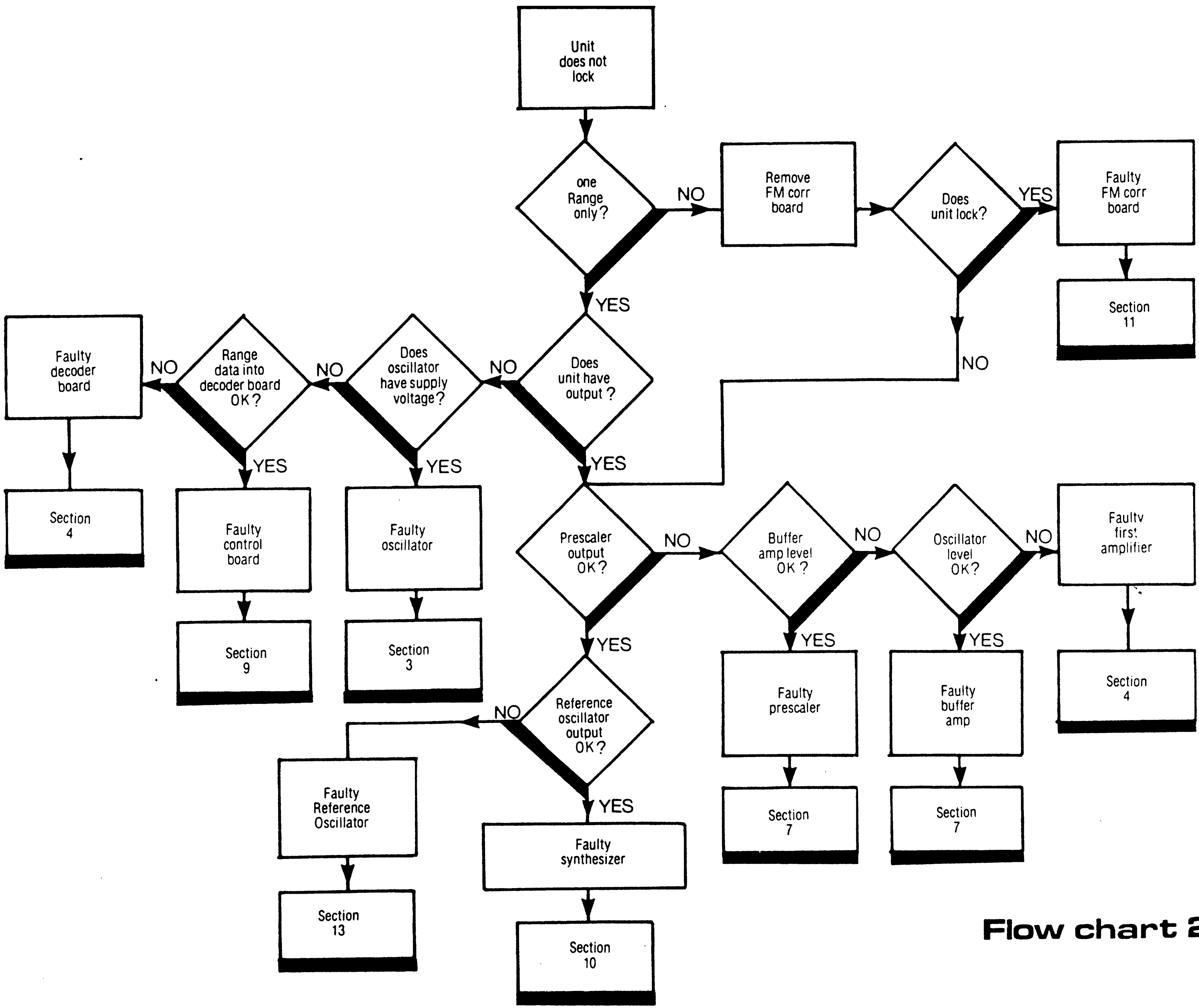


REVERSE POWER PROTECTION (OPTION D)

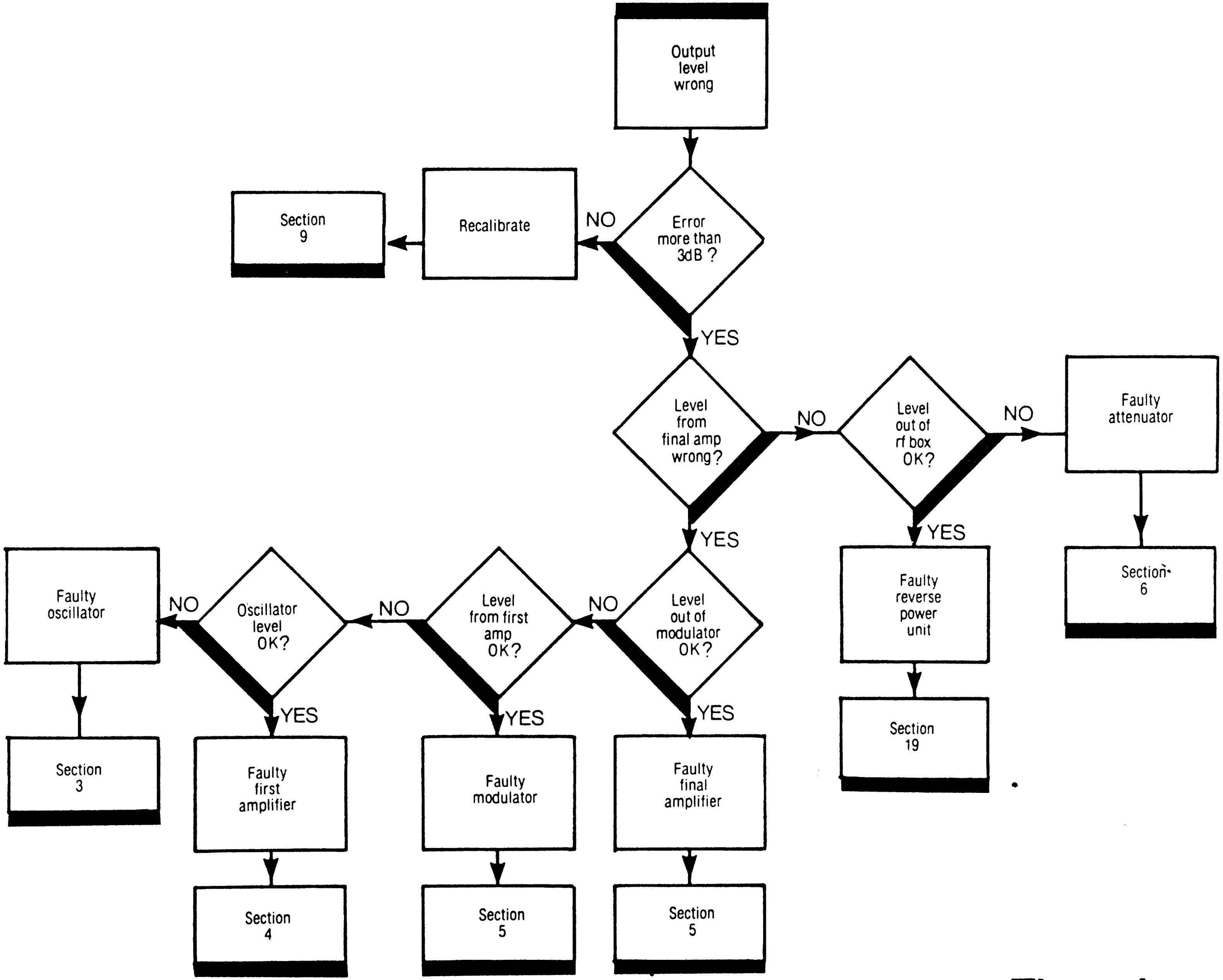
This circuit is completely enclosed in a metal box behind the front panel. It is fitted in the solid coaxial output line and sealed to prevent r.f. leakage. Any fault developing in this unit is best rectified therefore by complete unit replacement. In an emergency, however, the box lid can be carefully unsoldered and components replaced. It is very important to replace all the components in exactly the same position as the original ones before resoldering on the lid.

To remove the reverse power protection box, first remove the front panel (see instrument dismantling instructions). Then remove the large nut securing the type 'N' output connector to the front panel. Remove the clip securing the solid coaxial output line to the attenuator switch assembly and remove the supply line wire from the feedthrough connection on the reverse power box.

The complete output coaxial line and box assembly can then be removed from the front panel.

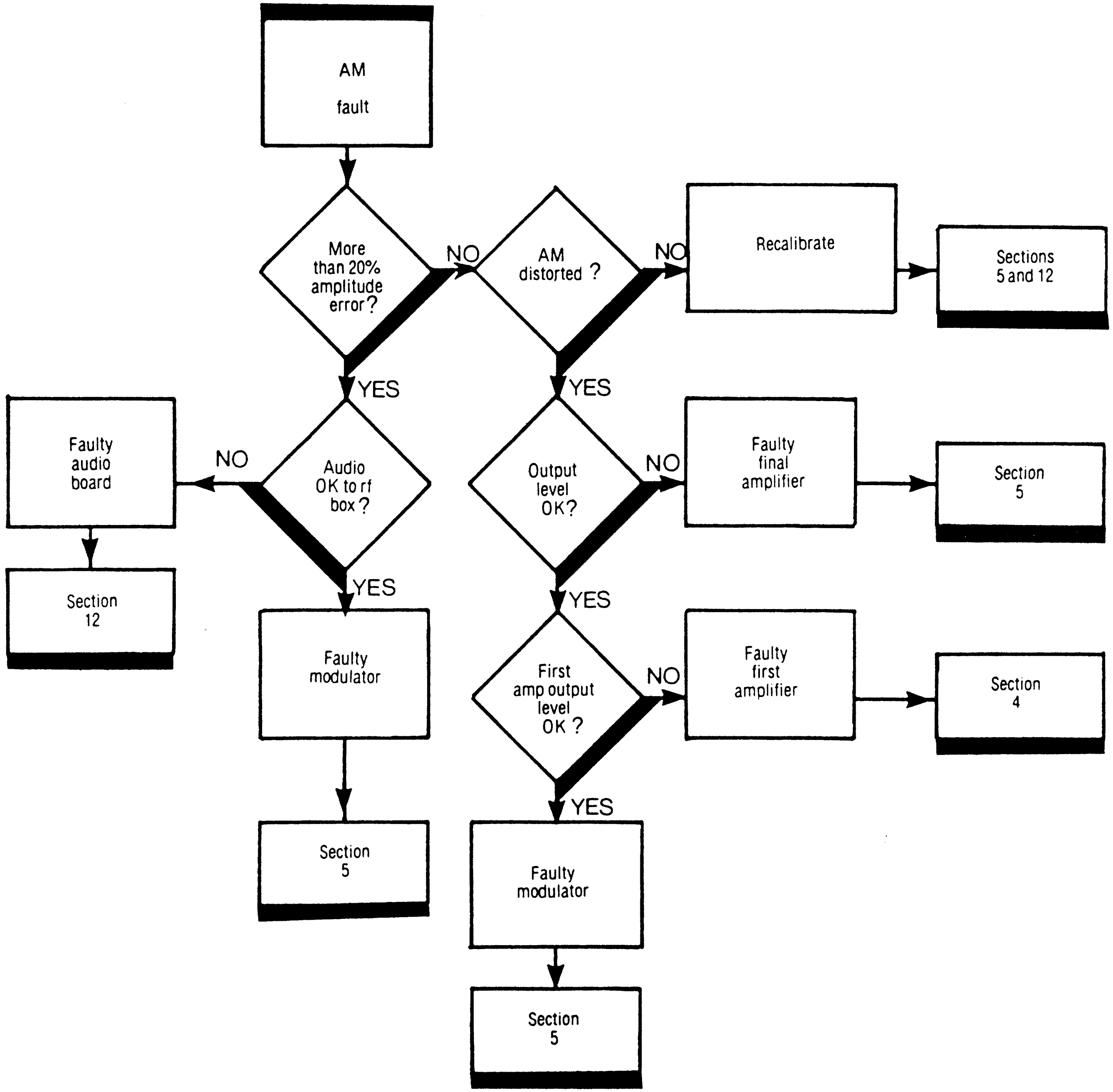

Unit does not lock
one Range only?
NO
Remove FM corr board
Does unit lock?
YES
Faulty FM corr board
Section 11
NO
YES
Does unit have output ?
NO
Does oscillator have supply voltage?
YES
Faulty oscillator
Section 3
NO
Range data into decoder board OK?
YES
Faulty control board
Section 9
NO
Faulty decoder board
Section 4
YES
Prescaler output OK?
NO
Buffer amp level OK ?
YES
Faulty prescaler
Section 7
NO
Oscillator level OK?
YES
Faulty buffer amp
Section 7
NO
Faultv first amplifier
Section 4
YES
Reference oscillator output OK?
YES
Faulty synthesizer
Section 10
NO
Faulty Reference Oscillator
Section 13

Flow chart 2



Output level wrong
Error more than 3dB ?
NO
Recalibrate
Section 9
YES
Level from final amp wrong?
NO
Level out of rf box OK?
NO
Faulty attenuator
Section 6
YES
Faulty reverse power unit
Section 19
YES
Level out of modulator OK?
YES
Faulty final amplifier
Section 5
NO
Level from first amp OK?
YES
Faulty modulator
Section 5
NO
Oscillator level OK?
YES
Faulty first amplifier
Section 4
NO
Faulty oscillator
Section 3

Flow chart 3

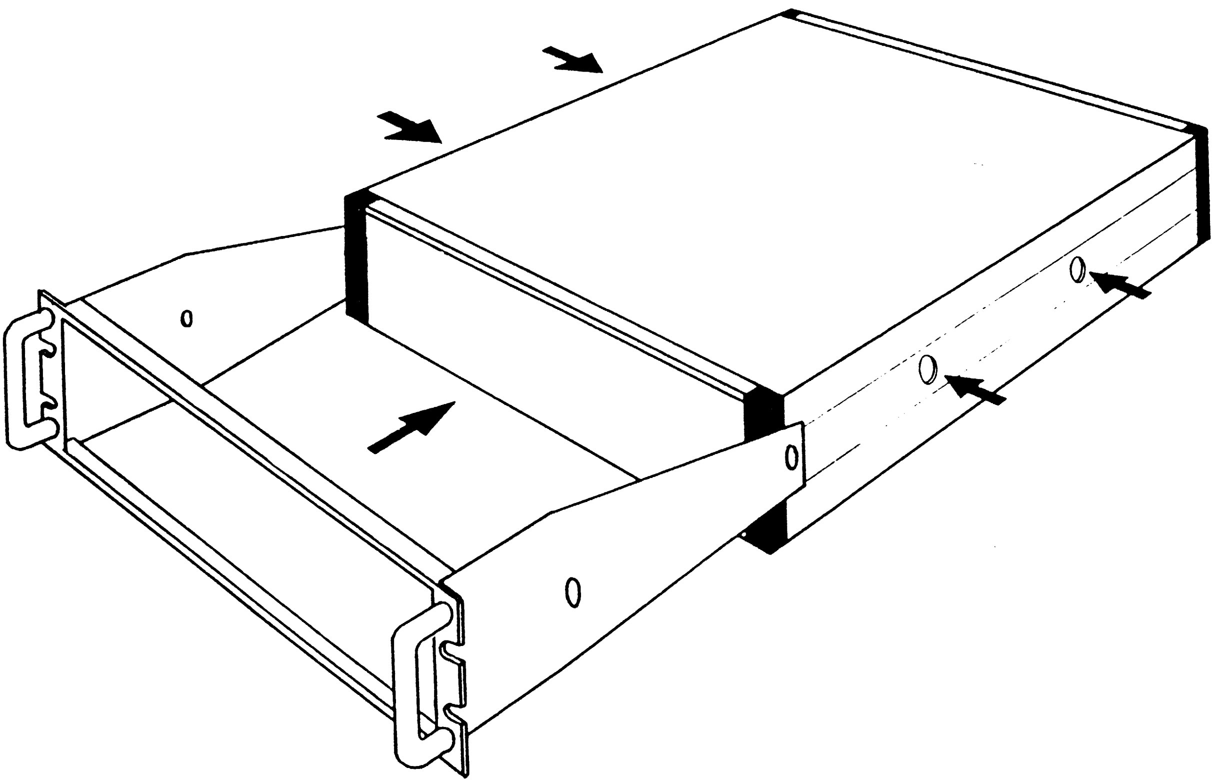

AM
fault
More than 20% amplitude error?
NO
YES
AM distorted ?
NO
YES
Recalibrate
Sections 5 and 12
Audio OK to rf box?
NO
YES
Faulty audio board
Section 12
Faulty modulator
Section 5
Output level OK?
NO
YES
Faulty final amplifier
Section 5
First amp output level OK ?
NO
YES
Faulty first amplifier
Section 4
Faulty modulator
Section 5

Flow chart 4

RACK MOUNTING (OPTION E)

This consists of two side plates linked by two bars. The assembly fits around the instrument front panel without any modification.

To fit, remove the two large screws in each side handle and push the rack assembly over the front panel until the side plate holes align with the chassis holes. Fix the side plates by replacing the four screws.



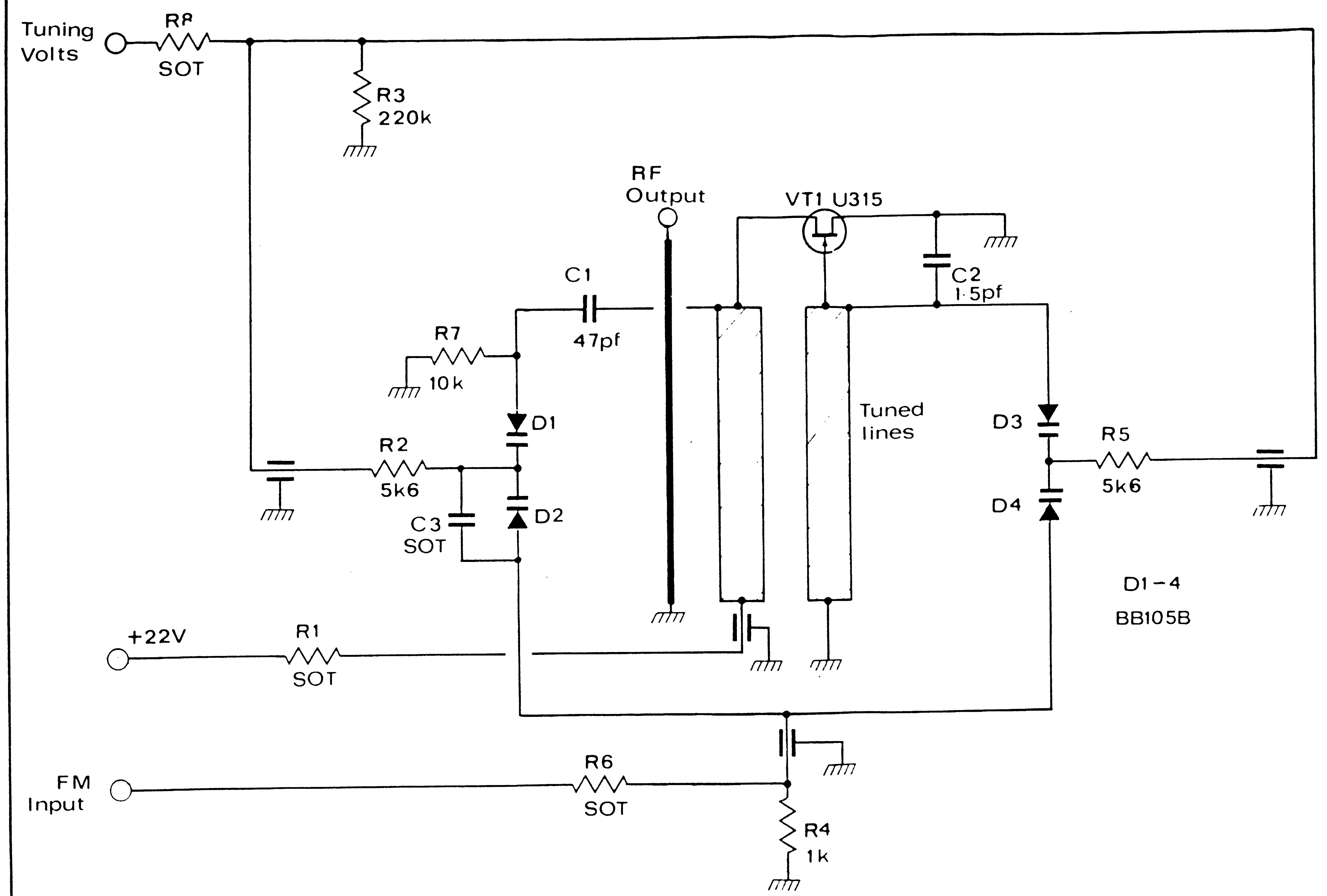
MODEL CHANGES

Unless specially modified the following model changes were effected at and including the specified serial number.

8320176-3	2MHz external reference changed to 1MHz Stripline oscillator 'hard start' circuit added
8320206-4	Option A frequency adjustment has extra fine potentiometer control
8320232-5	'Carrier off' switch added concentric with r.f. 'set level' control
8320267-6	FM correction board IC13 changed
8320275-6	SINAD meter calibrated against true r.m.s. standard
8320326-9	Ovened crystal reference changed to bracket mounting type

DRAWING No. 3SZ0832170									
R	8	1	3	2	7	6	4	5	R
C						1	2		C
VT							1		VT
MISC			D1,2				D3,4		MISC

USED ON



TRACED					
CHECKED	C	6.4.78	4574(2)		
S.D.	B	7.12.77.	Q4409P		
DRAWN J.N.	ISS	DATE	MOD No		
	A	14.10.77	—		

FARNELL INSTRUMENTS LTD. WETHERBY.

TITLE STRIP LINE OSCILLATOR SSG520 *Section 19 issue 1 11·78*

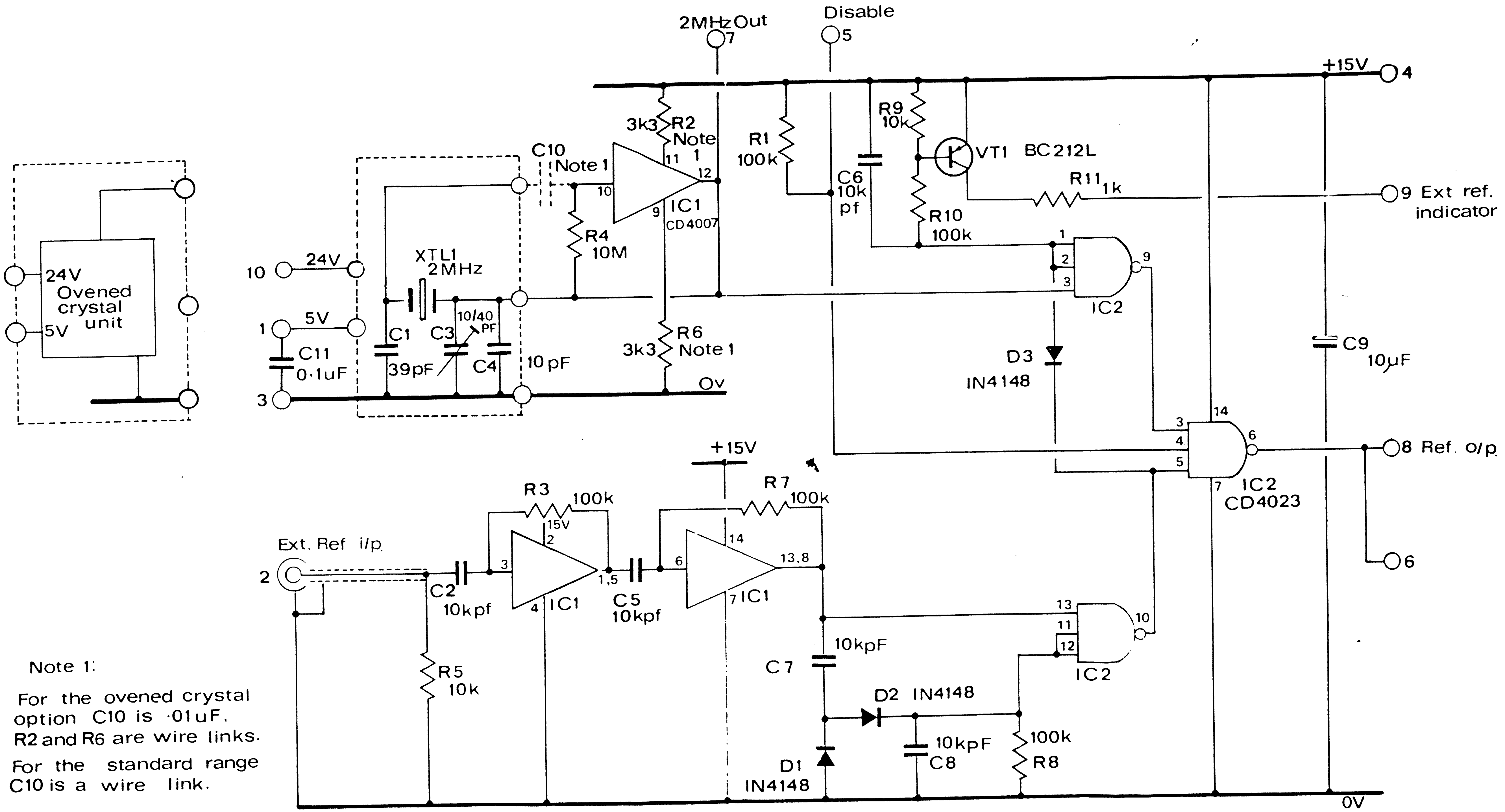
DRAWING No 3SZ0832170

SHEET OF SHEETS

DRAWING No. 3ZX0832164

USED ON

R	5 3 4 2,6 7 1 9 10 8 11
C	1 2 3 4 10 5 7 6 8 9
VT	1
MISC	XTL1 IC1 IC1 IC1 D1 D2 D3 IC2 IC2



Note 1:

For the ovened crystal option C10 is ·01uF. R2 and R6 are wire links.

For the standard range C10 is a wire link.

TRACED			
CHECKED	C	20.6.78	Q4745
	B	8.12.77.	Q4456P
DRAWN J.N.	ISS	DATE	MOD NO
	A	23.8.77	

TOLERANCES

MATERIAL

SCALE

PROTECTIVE FINISH

DIMENSIONS IN MM

NOTE: REMOVE ALL BURRS AND SHARP EDGES

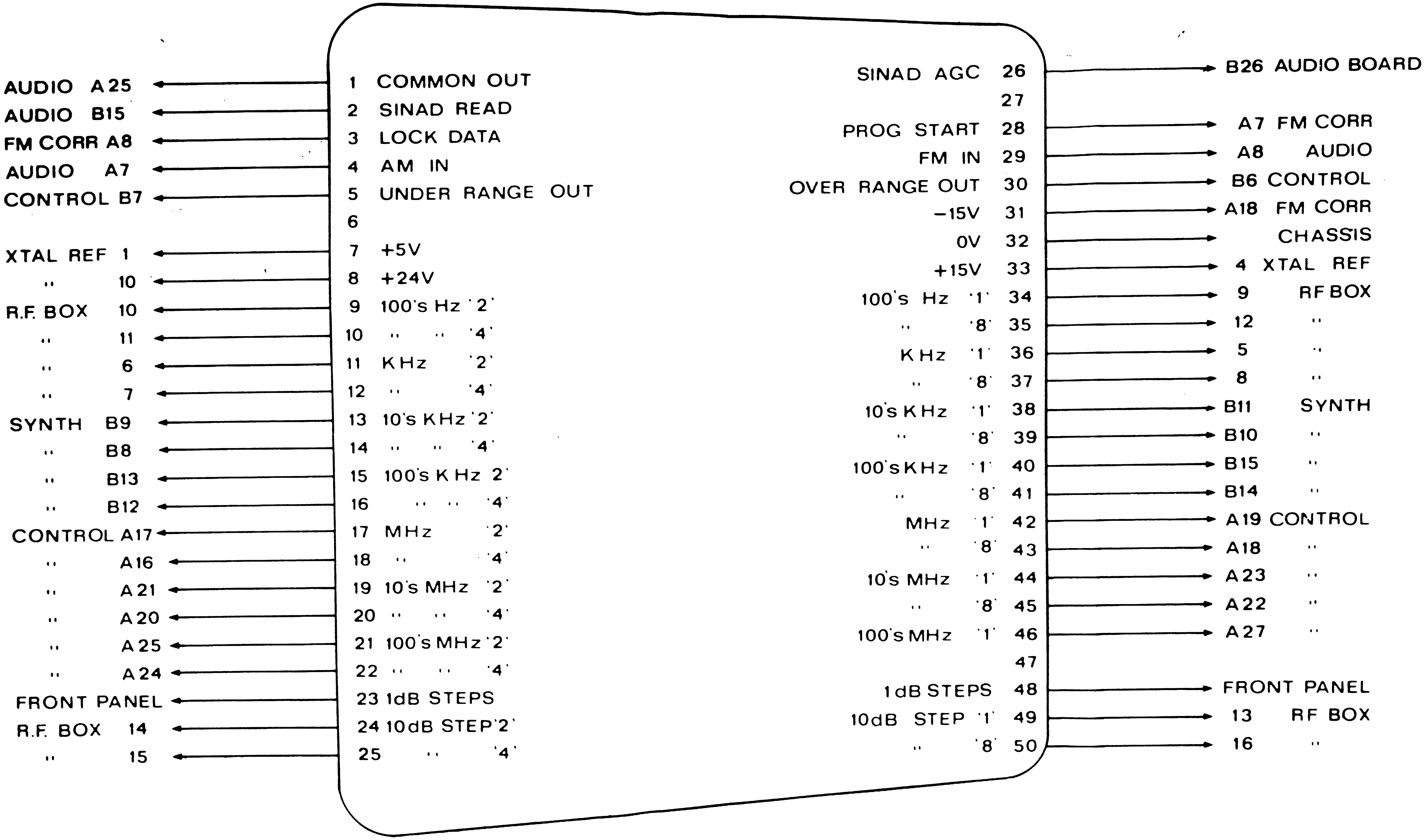
FARNELL INSTRUMENTS LTD. WETHERBY.

TITLE: REF. OSCILLATOR BOARD

Section 19 issue 1 11·78 SSG520

DRAWING No 3ZX0832164

SHEET 1 OF 1 SHEETS



TRACED	ISS.	DATE	MOD. No.	ISS.	DATE	MOD. No.	USED ON: F832
	A	22-8-78					
CHECKED	B	8-11-78	Q5047				
DRAWN A.M.							

NOTE.
CAPACITOR VALUES GIVEN IN µF
RESISTOR VALUES IN Ω
UNLESS OTHERWISE STATED

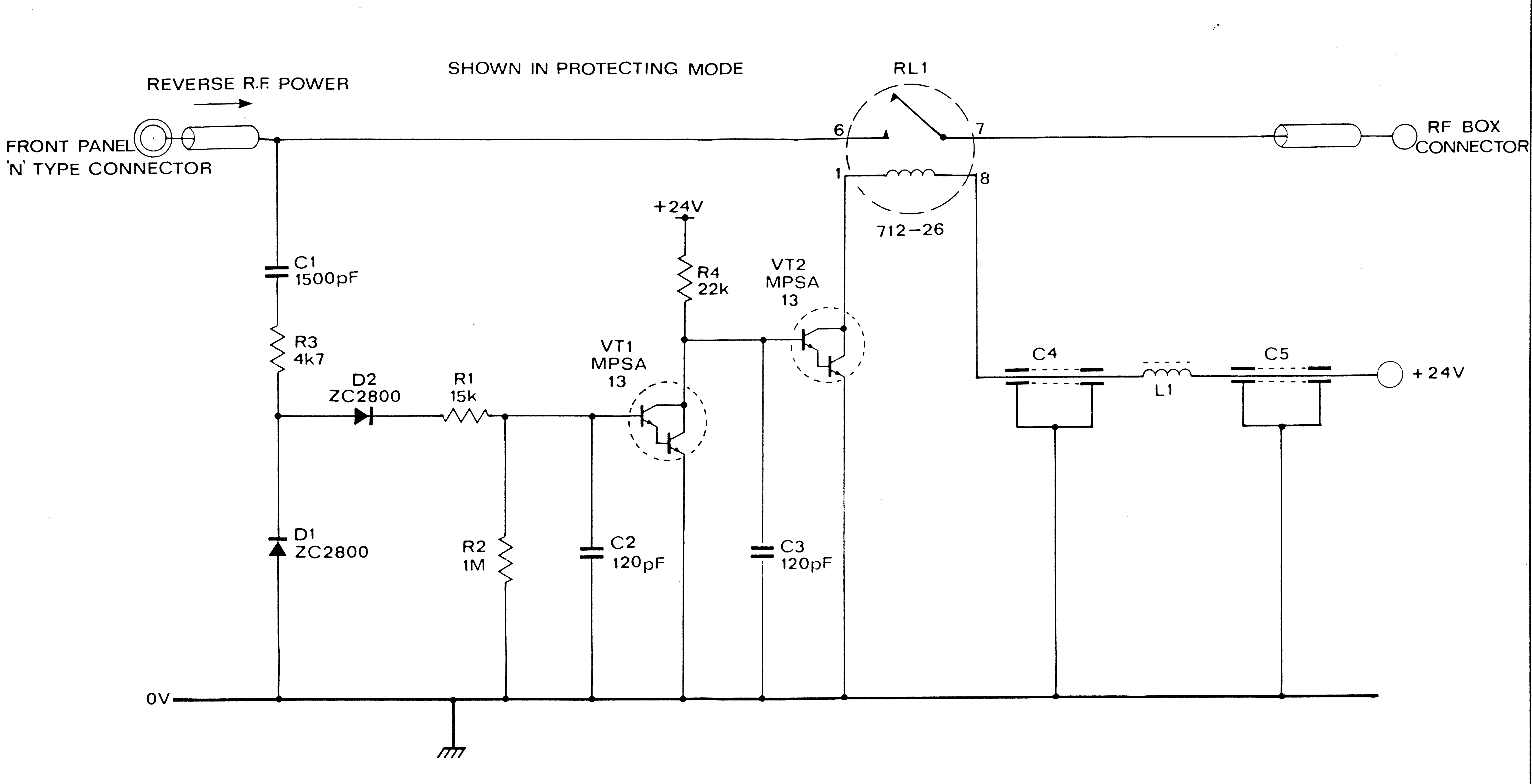
FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

TITLE
PROGRAMME SOCKET
WIRING DIAGRAM
Section 19 wire 1 11·78

DRAWING No
2ZV0832284

SHEET 1 OF 1 SHEETS

R	3		1	2	4						R
C	1			2			3		4	5	C
VT					1	2					VT
D	1	2									D
RL, L							RL1	L1			RL, L



TRACED	ISS.	DATE	MOD. No.	ISS.	DATE	MOD. No.	USED ON:
	A	4.10.78					
CHECKED	B	8.11.78	Q5077				
	C	25.9.80	Q6547				
DRAWN SM							

NOTE:
CAPACITOR VALUES GIVEN IN μF
RESISTOR VALUES IN Ω
UNLESS OTHERWISE STATED

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

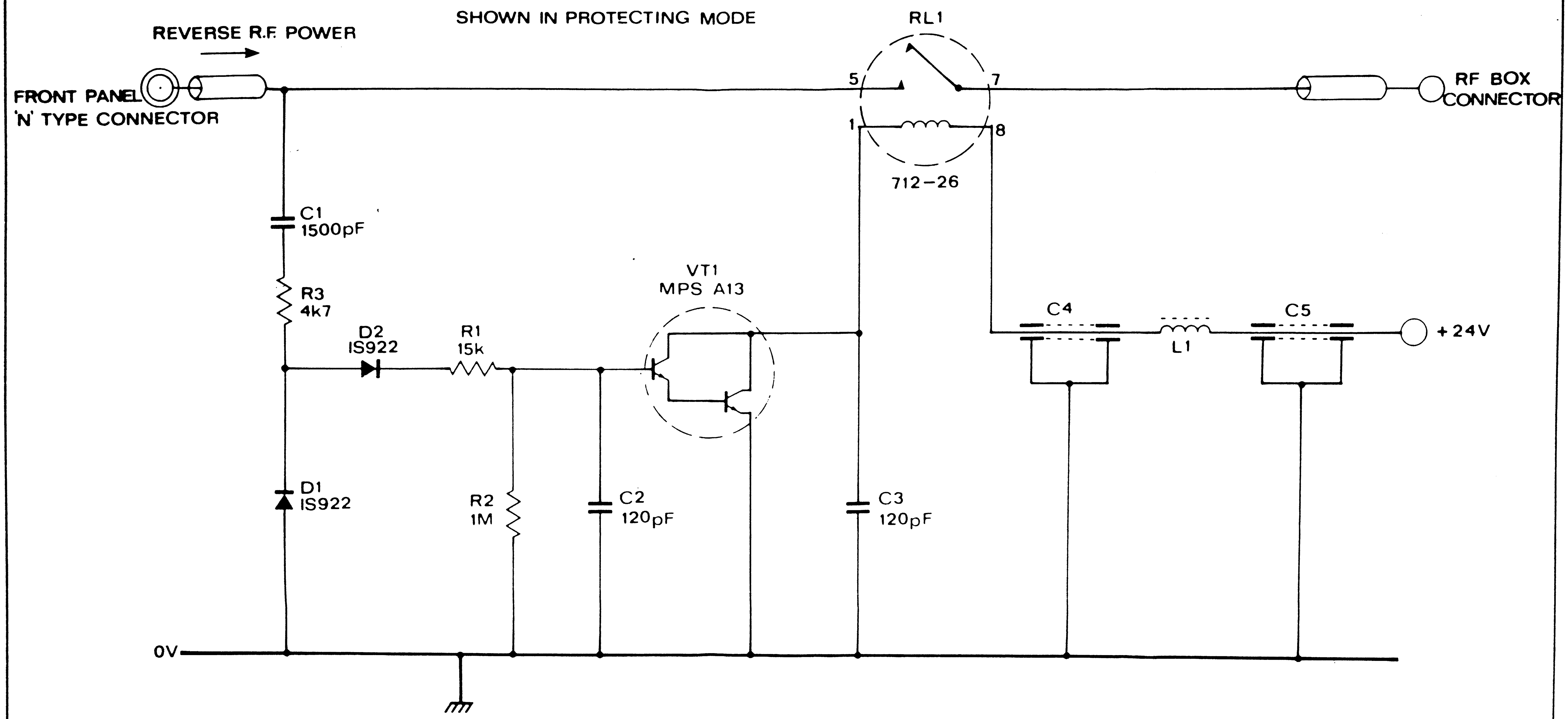
TITLE REVERSE POWER PROTECTION
OPTION D SSG 520

DRAWING No. 3ZX0832285

SHEET 1 OF 1 SHEETS

FICD3

R	3		1	2					R
C	1				2	3	4	5	C
VT					1				VT
D	1	2							D
RL, L						RL1	L1		RL, L



TRACED	ISS.	DATE	MOD. No.	ISS.	DATE	MOD. No.	USED ON
	A	4.10.78					
CHECKED	B	8.11.78	Q5077				
DRAWN SM							

NOTE:
CAPACITOR VALUES GIVEN IN µF
RESISTOR VALUES IN Ω
UNLESS OTHERWISE STATED

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

TITLE REVERSE POWER PROTECTION
OPTION D SSG 520
Section 19 issue 1 11·78

DRAWING No 3ZX0832285

SHEET 1 OF 1 SHEETS

FARNELL INSTRUMENTS LIMITED

COMPUTERISED PARTS LIST

IMPORTANT EXPLANATION - Please read before ordering parts

Due to limitations in the number of character spaces available the information in the circuit reference field has been abbreviated and the following notes are provided as a guide to its interpretation:-

1. Where a component is used more than once on a board the alphabetic portion of the circuit reference for its second and subsequent location has been omitted. e.g. The circuit reference information for a component located at R1 and R6 will appear as R1 6 .

2. The circuit reference numbers are presented in ascending decade blocks delimited by colons : second and subsequent numbers within a decade block represent only the unit value of the location (the tens and hundreds value being implied). e.g. For a component located at R54, R57, R59, R82, R87, R102, R110 and R112 the circuit reference entry will be R54 7 9 : 82 7 : 102 : 10 2.

3. Where components are used in a series of neighbouring circuit reference locations the circuit reference numbers are presented as inclusive blocks using a hyphen. e.g. A component located at R16, R19, R21, R24, R25, R26, R31, R37, R38, R39, R40, R44, R46 will be represented as R16 9 : 21 4-6 : 31 37-40 4 6 (if a series crosses a decade block the tens value is shown).

4. Comments are preceded by a semicolon.

When ordering replacement parts from Farnell Instrumetns Limited please be sure to quote the ITEM NUMBER provided.

PARTS LIST INDEX FOR SSG520

EXPLOS NO	TITLE
5N0832018	2MHz REF OSCILLATOR
27SSGNOC	NON CRYSTAL OVENED OPTION
27SSGOC	OVENED CRYSTAL OPTION A
47SSGFP	FRONT PANEL
4N0832011	STRIP LINE OSCILLATOR
4N0832012	ATTENUATOR
5N0832013	VARACTOR OSCILLATORS
5N0832015	RANGE DECODER
5N0832016	PRESCALER
5N0832014	AMPLITUDE MODULATOR
27SSGPS	POWER SUPPLY
27SSG5SY	SYNTHESIZER BRD
27SSG5AD	AUDIO BRD
27SSG5CC	CONTROL BRD
27SSG5FM	FM CORRECTION BRD
37SSG520	CASING (INC ACCESSORIES)
	R.F. BOX HARDWARE

PLOS 5N0832918 CPS/A *2HFZ REF OSC DATE 10/07/82

ITEM NUMBER	DESCRIPTION	*------------- CIPCUIT REFERENCE
RC0832287	2ZZ/A *PEF OSC * *	B
RC810M025	10MP 10% MUL CR25	R2 3 7
RM41K0025	1K0P 2% MUL MR25	R8
RM43K3025	3K3R 2% MUL MR25	R13
RM44K7025	4K7R 2% MUL MR25	R9:10
RM510K025	10KR 2% MUL MR25	R5
RM6100K25	100KR 2% MUL MR25	R1 4*P09 R6*P10
CC256P0N642	56PF 100V 642-34569	C7 8
CC41K00831H	1K0PF EPI 831/HIK	C12
CC510K0861	10KPF EPI 861T/25	C4 6
CE21F U0GM	10UF 25V MUL 015	C9
DG4148	DIODE 1N4148	D1-3
VD14023BCP	INT CCT MC14023BCP MOT	IC2*REMOVE ONLY VITH TOOL
VD4069BCN	INT CCT CD4069BCN NSC	IC1*REMOVE ONLY VITH TOOL
VS14L	IC SKT 703/4014 LOW/P	IC1 2
VT212PL	TRANSISTOR BC212PL	VT1*
0C	C/B CAPACITY FACTOR	0
RASOT	**** SELECT ON TEST ***	R11 2
CASOT	CAP SELECT ON TEST	C1-3 5:10 1
VP1A	TRANSITOR PAD TV1A	VT1
DZ212V00V5	ZPD12 ITT	Z1

:XPLOS 27SSGNOC   FIN/A *NO-OVEN CRY   DATE 10/07/82

ITEM NUMBER	DESCRIPTION	*------------- CIRCUIT REFERENCE
VX2000T	CRYSTAL 2.000MHZ 4203	X1
CS239P6S139	39PF 350V STA MS1391	C1
CV2104 0P21	V/CAP 10/40PF 10S/21	C2
CS218P6S124	18PF 350V 124-645	C3
YT22	T/C WIRE 22SWG	LINK C5 (DO NOT FIT LINKS 1-3)

EXPLOS 27SS60C FIN/A *OVEN CRYST DATE 10/07/82

ITEM NUMBER	DESCRIPTION	*------------- CIRCUIT REFERENCE
VX2000C	CRYSTAL 2.000MHZ 5953	X1
PM510K043P	10KR SPL 43P T040	P1
PM547K025	47KR 2% MUL MR25	R11
PM533K025	33KR 2% MUL MR25	R12
CC510K0861	10KPF ERI 861T/25	C10
CC0U100811	0U1F ERI 811/T/30	C11
CP510K0PTFM	10KPF 160V VIM TFM	C5
YT22	T/C WIRE 22SWG	LINK 1 3 FOR 6 PIN OVEN,
		LINK 2 FOR 5 PIN OVEN

EXPLOS 47SSGFP FIN/ *F/PANEL DATE 10/07/82

ITEM NUMBER	DESCRIPTION	*------------- CIRCUIT REFERENCE
4N0832SW4	SUB/A *SW4 ASM SSG520 *	4
4N0832SW5	SUB/A *SW5 ASM SSG520 *	4
SW832153	4ZP/D *WAFER ATTN 2 *	SW5
PM554K948	54K99R 0.5% 50PPM H8	R16
PM566K1H8	66K14R 0.5% 50PPM H8	R15
PM580K7H8	80K73R 0.5% 50PPM H8	R14
PM6100KH85	100K48R 0.5% 50PPM H8	R13
PM6128KH8	128K46R 0.5% 50PPM H8	R11
PM6171KH8	171KR 0.5% 50PPM H8	R9
PM6242KH8	242K35R 0.5% 50PPM H8	R7
PM6386KH8	386K14R 0.5% 50PPM H8	R5
PM6819KH8	819K96R 0.5% 50PPM H8	R4
PM42K2025	2K2R 2% MUL MR25	R19
DG4148	DIODE 1N4148	D1-4
4N0832SW6	SUB/A *SW6 ASM SSG520 *	4
PM510K025	10KR 2% MUL MR25	R1
PM539K025	39KR 2% MUL MR25	R2
PM6150K25	150KR 2% MUL MR25	R3
CT2100UG6M10	10UF 25V UNC E6K10E	C5
SW832154	4ZP/B *WAFER FM RANGE *	SW6
PM45K6025	5K6R 2% MUL MR25	R17
CC41K00831H	1K0PF ERI 831/HIK	C6 7
CC3470P831H	470PF ERI 831/HIK	C8
CF11U00LA2B	1UF 63V ASH A2B	C1-4
DG4148	DIODE 1N4148	D5
EM0832151	320/E *SSG DS28 *	M1
EM620	200VA 620/621 SSG520	M2
PC510K0AR45	POT 10KR+SW ABE AR45	P3
PM45K001301	5K0R COL CT1301	P1 2
LD140RED	LED RED FLV140	LED1 2
LD340GR	LED GREEN FLV340	LED4 5
LD440YL	LED YELLOW FLV440	LED3
SL0832150	4ZP/A *THUMB SW SSG520*	SW9
ST7203J	PADDLE SW 7203/J2/Z0	SW2 3
ST7303J	PADDLE SW 7303/J2/Z0	SW1
SW832155	4ZP/B *WAFER MTR FUNC *	SW7
TR161323	N CON R161/323 RAD	SKT4
TR0281	SMA PLUG 142/0281/001	PL1
TR1094	BNC SKT UG1094/BU RAD	SKT1-3
CD41K751214	F/CAP 1K75PF ERI 1214	C9
HW0832190	PLASTIC FRONT PANEL	
HD0832210	ATTENUATOR DIAL (2 OFF) BLACK	
HD0832248	ATTENUATOR DIAL (2 OFF) CLEAR	
HK150	KNOB CAP C150 (5 OFF)	
HK151	NUTCOVER N151 (3 OFF)	
HK15125	KNOB S151250 (3 OFF)	
HK1516	KNOB W151006 (2 OFF)	
HK210	KNOB CAP C320 (2 OFF)	
HK211006	KNOB K211006 (2 OFF)	
HK110125	KNOB K110125 (1 OFF) RED	
HK110R	KNOB CAP C110 (1 OFF) RED	
HG400	PUSH ROD SPRING	
HW0832213	POWER PUSH ROD	
HM0832226	BLACK MOULDING	

EXPLOS 4N0832011 SUB/C *S/LINE OSC DATE 10/07/82

ITEM NUMBER	DESCRIPTION	*------------- CIRCUIT REFERENCE
5N0832011	CPS/A *STRIP LINE	* 5
BC0832140	2ZZ/B *STRIP OSC *	* B
PC73M9025	3M9R 10% MUL CR25	R8
PM256R025	56R 2% MUL MR25	R11
PM44K7025	4K7R 2% MUL MR25	R10
PM510K025	10KR 2% MUL MR25	R9
CE215U0JM	15UF 40V MUL 015	C4
DG4148	DIODE 1N4148	D5
VTA13	TRANSISTOR MPS/A/13	VT2*
TP853	EYELETS G853	TP1 2
VT182PL	TRANSISTOR BC182PL	VT3*
0C	C/B CAPACITY FACTOR	0
RASOT	**** SELECT ON TEST ***	R1
VP1A	TRANSITOR PAD TV1A	VT2 3
TP15080	CB PIN MR15080 TUC	C/S X4
PM41K0025	1K0R 2% MUL MR25	R4
PM45K6025	5K6R 2% MUL MR25	R2 5
PM510K025	10KR 2% MUL MR25	R7
PM533K025	33KR 2% MUL MR25	R3
CC11F50861	1P5F EPI 861/P100	C2
CC247P0YD	47PF EPI YD/N750	C1
DG105B	DIODE BA105BM	D1-4
CD41K00N54	1K0P 54-794-001-102P	X5
VTBF256B	TRANS BF256B MUL	VT1
PM3100R25	100R 2% MUL MR25	R12
CC41K00N630	1K0PF 100V 630-06102	C5
RASOT	**** SELECT ON TEST ***	R6
CASOT	CAP SELECT ON TEST	C3

EXPLOS 4N0832912 SIB/A *ATTEN DATE 10/07/82

ITEM NUMBER	DESCRIPTION	*------------- CIRCUIT REFERENCE
RM261R155	61R1 1% RES RC55	R4 5
RM271R255	71R2 1% RES RC55	R3
RM296R355	96R3 1% RES RC55	R1 2
RM3100R25	100R 2% MUL MR25	R7-14
RM42K4025	2K4R 2% MUL MR25	R15 6
CC11P50861	1P5F ERI 861/P100	C9-14
CC13P30861	3P3F ERI 861/NPO	C15 6
CD41K751214	F/CAP 1K75PF ERI 1214	C1-8
DG4148	DIODE 1N4148	D1
SR71226	RELAY 712/26 TEL	RL1-6
RM3247R55	247R 1% RES RC55	R6

XPLOS 5N0832013 CFS/A *VARACTOR OSC DATE 10/07/82

ITEM NUMBER	DESCRIPTION	*------------- CIRCUIT REFERENCE
PC0832100	2Z7/D *VAR OSC * *	B
RM210R025	10R 2% MUL MR25	R39*P09 R69*P12
RM222R025	22R 2% MUL MR25	R70 1
RM247R025	47R 2% MUL MR25	R4:10 6:22:30:45:51 7:63
RM41K0025	1K0R 2% MUL MR25	R1 7:13:35:42 8:54
RM41K5025	1K5R 2% MUL MR25	R36
RM42K2025	2K2R 2% MUL MR25	R26:67
RM43K9025	3K9R 2% MUL MR25	R34
RM44K7025	4K7R 2% MUL MR25	R3 9:15:38:44:50 6
RM510K025	10KR 2% MUL MR25	R5:11 7:21 3 5 9:31 3:40 6:52 8 :62 4 6 8
RM518K025	18KR 2% MUL MR25	R19:60
RM527K025	27KR 2% MUL MR25	R27
RM547K025	47KR 2% MUL MR25	R2 8:14:20 8:37:43 9:55:61
CC14P70861	4P7F ERI 861/N470	C9:15:47:69
CC15P60861	5P6F ERI 861/N470	C36
CC210P0YD	10PF ERI YD/NPO	C2-4 8:21:40 1:53
CC215P0YD	15PF ERI YD/NPO	C14:20:35:46:52 9
CC218P0YD	18PF ERI YD/NPO	C28
CC222P0YD	22PF ERI YD/NPO	C10:27:34:58
CC247P0YD	47PF ERI YD/N750	C22:54
CC3100P801	100PF ERI 801/N1500	C60
CC3120P861	120PF ERI 861/N470C	C11 7:23:30:43 9:55:61
CC3220P831H	220PF ERIE 831/HI-K	C29
CC3470P831H	470PF ERI 831/HIK	C1 7:13:33 9:45:51
CC41K00831H	1K0PF ERI 831/HIK	C6:12 8:24:31 8:44:50 6:62 4 5 8
CC44K70801	4K7PF ERI 801/AX	C19:25 6:32:57:63 6 7:70-74
DG3168	DIODE 5082/3168 HP	D3 6 9:14 9:22 5 8:31 6 7
VT245B	TRANSISTOR BF245B	VT6*
VF5245	2N5245 TEXAS ONLY	VT1-5 7-10*
ZC15U10	CHOKE 15UH SC10 ITT	L1 3 5 9:11 3 5
ZC0832301	3Z0/A *CHK VAR OSC L8 *	L8
ZC0832302	3Z0/A *CHK VAR OSC L17*	L17
ZC0832303	3Z0/A *CHK VAR OSC L7 *	L7
ZC0832304	3Z0/A *CHK VAR OSC L16*	L16
ZC0832305	3Z0/A *CHK VAR OSC L6 *	L6
ZC0832306	3Z0/A *CHK VAR OSC L14*	L14
ZC0832307	3Z0/A *CHK VAR OSC L4 *	L4
ZC0832308	3Z0/A *CHK VAR OSC L12*	L12
ZC0832309	3Z0/A *CHK VAR OSC L2 *	L2
ZC0832310	3Z0/A *CHK VAR OSC L10*	L10
DG105B	DIODE BB105BM	D1 2 4 5 7 8:10-13 15-18 :20 1 3 4 6 7 9:30 32-35
0C	C/B CAPACITY FACTOR	0
TP15080	CB PIN MR15080 TUC	C/S X27 T/S X15
RASOT	**** SELECT ON TEST ***	R6:12 8:24:32:41 7:53 9:65
CAOMIT	CAPACITORS OMITTED	C5
VP1A	TRANSITOR PAD TV1A	VT1-10

EXPLOS 5N0832015 CPS/B *ASC RANGE DATE 10/07/82

ITEM NUMBER	DESCRIPTION	*------------ CIRCUIT REFERENCE
BC0832136	2Z7/A *AGC *	* B
RC6560K25	560KR 5% MUL CR25	R55
RM210R025	10R 2% MUL MR25	R56
RM256R025	56R 2% MUL MR25	R7
RM3100R25	100R 2% MUL MR25	R1
RM3220R25	220R 2% MUL MR25	R9
RM3390R25	390R 2% MUL MR25	R54
RM3470R25	470R 2% MUL MR25	R4
RM3680R30	680R 2% MUL MR30	R11
RM3820R25	820R 2% MUL MR25	R2
RM41K0025	1K0R 2% MUL MR25	R3
RM41K8025	1K8R 2% MUL MR25	R6
RM42K2025	2K2R 2% MUL MR25	R53
RM44K7025	4K7R 2% MUL MR25	R10
RM510K025	10KR 2% MUL MR25	R8:12 3 7 8 9:42-52
RM518K025	18KR 2% MUL MR25	R5
RM533K025	33KR 2% MUL MR25	R14 5
RM547K025	47KR 2% MUL MR25	R16:20-41
CC0U100811	0U1F ERI 811/T/30	C4 6:11 7
CC15P60861	5P6F ERI 861/N47J	C7
CC210P0YD	10PF ERI YD/NPO	C20
CC3120PYD	120PF ERI YD/SN1100	C16
CC3180P861	180PF ERI 861/N5600	C10
CC3470P831H	470PF ERI 831/HIK	C1-3 8
CC44K70N8121	4K7PF 100V ERI 8121	C12-14
CC510K0861	10KPF ERI 861T/25	C5
CT210U0KP	10UF 50V TAP10/50	C15
CT222U0GG	22UF 25V TAG22/25	C18
DG2835	DIODE 5082/2835 HP	D2 3
DG3080	DIODE 5082/3080 HP	D1
DG4148	DIODE 1N4148	D4-7
PM510K063P	10KR SPL 63P	P1
VA3130E	INT CCT CA3130E RCA	IC1*REMOVE ONLY WITH TOOL
VS16L	IC SKT 703/4016 LOW/P	V
VS8P	IC SKT 703/4008 LOW/P	V
VTR90	TRANSISTOR BFR90	VT1
ZC0832311	3Z0/A *CHOKE NO1	* L1-3
VT182PL	TRANSISTOR BC182PL	VT3-15*VP1A
VT212PL	TRANSISTOR BC212PL	VT16-26*VP1A
CF0U470LA2B	0.47UF 63V ASH A2B	C9
VD4028AE	INT CCT CD4028AE RCA	IC2 3*REMOVE ONLYWITH TOOL
OC	C/B CAPACITY FACTOR	0
VT901	TRANSISTOR MRF901	VT2
VP1A	TRANSITOR PAD TW1A	VT3-26
TP619	CE PIN P619C	T/S X23
CAOMIT	CAPACITORS OMITTED	C9
TP3	TRACK PIN TC3 HAR	X8

ITEM NUMBER	DESCRIPTION	*------------- CIRCUIT REFERENCE
BC0832108	2ZZ/D *PRESCALER *	* B
PC6560K25	560KR 5% MUL CR25	R16
PM210R025	10R 2% MUL MR25	R39:40
PM256R025	56R 2% MUL MR25	R1 9
PM3100R25	100R 2% MUL MR25	R21-5:37 8:41
PM3180R25	180R 2% MUL MR25	R26
PM3220R25	220R 2% MUL MR25	R14
PM3270R25	270R 2% MUL MR25	R27
PM3330R25	330R 2% MUL MR25	R32
PM3390R25	390R 2% MUL MR25	R11
PM3470R25	470R 2% MUL MR25	R7
PM3560R25	560R 2% MUL MR25	R31 33-36:42
PM3820R25	820R 2% MUL MR25	R2*P09 R28*P12
PM41K0025	1K0R 2% MUL MR25	R3*P09 R43*P12
PM41K8025	1K8R 2% MUL MR25	R8
PM42K2025	2K2R 2% MUL MR25	R5*P09 R44*P12
PM44K7025	4K7R 2% MUL MR25	R10*P12 R13*P09
PM48K2025	8K2R 2% MUL MR25	R18
PM510K025	10KR 2% MUL MR25	R12 7*P09 R29:30*P12
PM518K025	18KR 2% MUL MR25	R6
PM533K025	33KR 2% MUL MR25	R19:20
PM6100K25	100KR 2% MUL MR25	R45-48
CC0U100811	0U1F ERI 811/T/30	C4 6:12
CC210P0861	10PF ERI 861/N470	C7
CC3120PYD	120PF ERI YD/SN1100	C11
CC3180P861	180PF ERI 861/N5600	C9
CC41K00831H	1K0PF ERI 831/HIK	C20
CC510K0861	10KPF ERI 861T/25	C5:17
CE222U0GM	22UF 25V MUL 015	C14
CE247U0DM	47UF 10V MUL 015	C21
CF510KON2MIN	10KPF 100V WIM FKS2MIN	C18
DG2835	DIODE 5082/2835 HP	D2 3
DG3080	DIODE 5082/3080 HP	D1
DG0A47	DIODE 0A47	D4
PM510K063P	10KR SPL 63P	P1
VA3130E	INT CCT CA3130E RCA	IC1*REMOVE ONLY WITH TOOL
VD10109P	INT CCT MC10109P MOT	IC4*REMOVE ONLY WITH TOOL
VD10137P	INT CCT MC10137P MOT	IC3*REMOVE ONLY WITH TOOL
VD12013P	INT CCT MC12013P MOT	IC2 7*REMOVE ONLY WITH TOOL
VD74190N	INT CCT SN74190N TEX	IC8*REMOVE ONLY WITH TOOL
VS14L	IC SKT 703/4014 LOW/P	IC6
VS16L	IC SKT 703/4016 LOW/P	IC7 8
VS8P	IC SKT 703/4008 LOW/P	IC1
VTR90	TRANSISTOR BFR90	VT1
ZC1U10	CHOKE 1UH SC10 ITT	L4
ZC0832311	3Z0/A *CHOKE N01	* L1-3
CC3470P831H	470PF ERI 831/HIK	C1-3 8*C2*P07
CC44K70N8121	4K7PF 100V ERI 8121	C13 5 6
VT182PL	TRANSISTOR BC182PL	VT2 4*
VD10131P	INT CCT MC10131P MOT	IC5*REMOVE ONLY WITH TOOL
PM3680R30	680R 2% MUL MR30	R15
CF0U470LA2B	0.47UF 63V ASH A2B	C10
CF547K5NMKS	47KPF 100V 20% MKS4	C19:22-24
0C	C/B CAPACITY FACTOR	0
VD74LS74N	INT CCT SN74LS74N TEX	IC6*REMOVE ONLY WITH TOOL
CD41K00N54	1K0P 54-794-001-102F	X14
TP15080	C6 PIN MR15080 TUC	C/S X6
VT901	TRANSISTOR MRF901	VT3

EXPLOS 5N0832014 CPS/F *AM MOD OPT DATE 10/07/82

ITEM NUMBER	DESCRIPTION	*------------ CIRCUIT REFERENCE
BC0832104	2ZZ/D *AMP MOD *	* B
PM222R025	22R 2% MUL MR25	R4
PM268R025	68R 2% MUL MR25	R24
PM3180R25	180R 2% MUL MR25	R1
PM3220R25	220R 2% MUL MR25	R26 8
PM3270R25	270R 2% MUL MR25	R39:40
PM3470R25	470R 2% MUL MR25	R27:32
PM3820R25	820R 2% MUL MR25	R15
PM41K0025	1K0R 2% MUL MR25	R3 7-9:14 6:20
PM41K8025	1K8R 2% MUL MR25	R18:23:33 4
PM44K7025	4K7R 2% MUL MR25	R12:30
PM45K6025	5K6R 2% MUL MR25	R11
PM46K8025	6K8R 2% MUL MR25	R2
PM48K2025	8K2R 2% MUL MR25	R36
PM510K025	10KR 2% MUL MR25	R5:35
PM556K025	56KR 2% MUL MR25	R17:25
PM568K025	68KR 2% MUL MR25	R22
PX6270KT4	270KR 2% ELC TR4	R38
CC0U10U811	0U1F ERI 811/T/30	C8:13 6:22
CC11P50861	1P5F ERI 861/P100	C3 9
CC13P30861	3P3F ERI 861/NPO	C20
CC14P70861	4P7F ERI 861/N470	C19
CC215P0YD	15PF ERI YD/NPO	C15
CC3120P861	120PF ERI 861/N4700	C23
CC3180P831	180PF ERI 831/N5600	C4 7
CC3470P831H	470PF ERI 831/HIK	C2:11 2:24:31
CC41K00861	1K0PF ERI 861/AX	C10
CC44K70801	4K7PF ERI 801/AX	C5
CC44K70N8121	4K7PF 100V ERI 8121	C26 7 9
CD41K751214	F/CAP 1K75PF ERI 1214	2 + 3
CF547K0R325	47KPF 250V B32511	C25
CT2100U0KP	10UF 50V TAP10/50	C28
CT222U0GG	22UF 25V TAG22/25	C1:18
DG2835	DIODE 5082/2835 HP	D5 6
DG3080	DIODE 5082/3080 HP	D1-4 9
DG4148	DIODE 1N4148	D7 8:10-13
PM510K063P	10KR SPL 63P	P2
PM525K063P	25KR SPL 63P	P1
VA3130E	INT CCT CA3130E RCA	IC1
VTR90	TRANSISTOR BFR90	VT1 3 4
ZC0832311	3Z0/A *CHOKE N01	* L4 5 6
VT182PL	TRANSISTOR BC182PL	VT2
PC810M025	10MR 10% MUL CR25	R29
PM3680R30	680R 2% MUL MR30	R31
PM210R025	10R 2% MUL MR25	R10:37
PM3390R25	390R 2% MUL MR25	R19
0C	C/B CAPACITY FACTOR	0
CC3470PN6306	470PF 100V 630-06471	C14 7:21
PM522K025	22KR 2% MUL MR25	R6:13
CAOMIT	CAPACITORS OMITTED	C30
ZAOMIT	WINDINGS OMITTED	L1
TP619	CB PIN F619C	C/S X7 T/S X6
VP1A	TRANSITOR PAD TW1A	VT2

EXPLOS 27SSGPS   FIN/A *PWR SUPPLY   DATE 10/07/82

ITEM NUMBER	DESCRIPTION	*------------- CIRCUIT REFERENCE --
5N0832022	CPS/A *PWR SUPPLY	* 5
BC0832132	ZZZ/C *PWR SUPP *	* B
PM215R025	15R 2% MUL MR25	R3
PM3330R25	330R 2% MUL MR25	R12
PM3560R25	560R 2% MUL MR25	R6
PM42K2025	2K2R 2% MUL MR25	R11
PM43K9025	3K9R 2% MUL MR25	R2
PM44K7025	4K7R 2% MUL MR25	R4:10
PM48K2025	8K2R 2% MUL MR25	R7
PM522K025	22KR 2% MUL MR25	R1 8 9
CE2100U0LM6	10UF 63V MUL 016	C15
CE233U0JM	33UF 40V MUL 016	C22
CE247U0JM	47UF 40V MUL 016	C23
CE3100UJM	100UF 40V MUL 016	C11:25
CE3220UIV	220UF 35V WIM PRNT	C27
CE3470ULW	470UF 63V WIM PRNT	C10*FITTED T/S
CE41K00IW	1K0UF 35V WIM PRNT	C8 *FITTED T/S
CE41K00LV	1K0UF 63V WIM PRNT	C9
CE42K20FW	2K2UF 16V WIM PRNT	C5 6 7*FITTED ON PINS *C7 FITTED T/S
CF0U100R325	0.1UF 250V B32511	C12-14 16-20 4 6
CF11U00LA2B	1UF 63V ASH A2B	C1-3
CF510K0N2MIN	10KPF 100V WIM FKS2MIN	C4
DG4003	DIODE 1N4003	D1-4:10-16 18-21*PJ9 D5-9:22*P12
DG4148	DIODE 1N4148	D17
PM41K0063P	1K0R SPL 63P	P1
PM42K0063P	2K0R SPL 63P	P2
VA741CG	INT CCT CA741CG RCA	IC5
VA79L15CP	INT CCT MC79L15CP MOT	IC6*VP1A
VS8P	IC SKT 703/4008 LOW/P	V
VT212PL	TRANSISTOR BC212PL	VT1 2*VP1A
CE2100U0GM	10UF 25V MUL 015	C28
CE3100UGM	100UF 25V MUL 016	C21
VA78M24CT	INT CCT MC78M24CT	IC4
CC	C/B CAPACITY FACTOR	0
RASOT	**** SELECT ON TEST ***	R5*ON PINS
TP619	CB PIN F619C	T/S X22
VP1A	TRANSITOR PAD TW1A	IC6:VT1 2
DZ16V500W4	BZV11 MUL	Z1
6N0832023PS	WPA/ *SSG520 P/S	* 6
VA78GU1C	INT CCT UA78GU1C FAR	IC1
VA78M15CU	INT CCT 78M15CU	IC2
VA7824CT	INT CCT MC7824CT	IC3
ZR0132	POWER TRANSFORMER	
SB206N	POWER SWITCH KPG206N	
TG6J4	POWER SKT AND FILTER	
HW0832241	HINGE & SPRING	
HB1002	HINGE	

EXPLOS 27SS65SY   FIN/C *SYNTHESIZER   DATE 10/07/82

ITEM NUMBER	DESCRIPTION	*------------- CIRCUIT REFERENCE
BC0832112	2Z7/B *SYNTH * *	B
PC6560K25	560KR 5% MUL CR25	R33
PC6820K25	820KR 5% MUL CR25	R36
PC71M0025	1M0R 5% MUL CR25	R30
PC810M025	10MR 10% MUL CR25	R34
PM210R025	10R 2% MUL MR25	R40
PM247R025	47R 2% MUL MR25	R21 4
PM3100R25	100R 2% MUL MR25	R44
PM3330R25	330R 2% MUL MR25	R22
PM41K0025	1K0R 2% MUL MR25	R23:32
PM510K025	10KR 2% MUL MR25	R29:37
PM518K025	18KR 2% MUL MR25	R35
PM6100K25	100KR 2% MUL MR25	R1-20 5 6 8
PM6150K25	150KR 2% MUL MR25	R41
PM6220K25	220KR 2% MUL MR25	R46
CC510K0861	10KPF ERI 861T/25	C18
CE3100UGM	100UF 25V MUL 016	C11 4
CE3220UFM	220UF 16V MUL 016	C6
CF0U220LCMD	0.22UF 63V ADV CMD6A	C8
CF11U00LA2B	1UF 63V ASH A2B	C15*DP40
CF41K50NFKS2	1K5PF 100V WIM FKS2	C7
CF547K0NMKS	47KPF 100V 20% MKS4	C9:10*DP10
DG4148	DIODE 1N4148	D4
DGEPAD100	DIODE EPAD/100 SIL	D2 3
VA3140E	INT CCT CA3140E RCA	IC18*REMOVE ONLY WITH TOOL
VD14017AE	INT CCT MC14017AE	IC6-9*REMOVE ONLY WITH TOOL
VD4001CN	INT CCT CD4001CN NSC	IC5 *REMOVE ONLY WITH TOOL
VD4011AE	CD4011AE RCA ONLY SSG	IC12*REMOVE ONLY WITH TOOL
VD4011BE	INT CCT CD4011BE RCA	IC3 *REMOVE ONLY WITH TOOL
VD4012AE	INT CCT CD4012AE RCA	IC4 *REMOVE ONLY WITH TOOL
VD4013AE	CD4013AE RAC ONLY SSG	IC11*REMOVE ONLY WITH TOOL
VD4023P	INT CCT HEF4023P SIG	IC2 *REMOVE ONLY WITH TOOL
VD4029AE	CD4029AE RAC ONLY SSG	IC13*REMOVE ONLY WITH TOOL
VD4029P	INT CCT HEF4029P SIG	IC14-17*REMOVE ONLY WITH TOOL
VD4078P	INT CCT HEF4078P SIG	IC10*REMOVE ONLY WITH TOOL
VD4093BCN	INT CCT CD4093BCN NSC	IC1 *REMOVE ONLY WITH TOOL
VT182PL	TRANSISTOR BC182PL	VT3*
VTX313	TRANSISTOR ZTX313	VT1 2*
ZC15U10	CHOKE 15UH SC10 ITT	L1
VS14L	IC SKT 703/4014 LOW/P	IC1-5:10 1 2
VS16L	IC SKT 703/4016 LOW/P	IC6-9:13-17
VS8P	IC SKT 703/4008 LOW/P	IC18
VP1A	TRANSITOR PAD TW1A	VT1-3
0C	C/B CAPACITY FACTOR	0
CF0U100NMKS3	0.1UF 100V WIM MKS3	C2 3 5:12 3
RLINK24	24 SWG TC LINK	R39
RAOMIT	RESISTORS OMITTED	R32:43 5
CAOMIT	CAPACITCRS OMITTED	C1:16 7

ITEM NUMBER	DESCRIPTION	*------------- CIRCUIT REFERENCE ---
BC0832124	2ZZ/C *AUDIO *	* B
PC71M0025	1M0R 5% MUL CR25	R3 4 8:15 7:21 2 4:31:42:55:92
PC72M2025	2M2R 10% MUL CR25	R43 4
PC74M7025	4M7R 10% MUL CR25	R49
PC810M025	10MR 10% MUL CR25	R63
PM3100R25	100R 2% MUL MR25	R30
PM3150R25	150R 2% MUL MR25	R6
PM3560R25	560R 2% MUL MR25	R27:64
PM3680R25	680R 2% MUL MR25	R50
PM41K0025	1K0R 2% MUL MR25	R11 3:23:76
PM41K8025	1K8R 2% MUL MR25	R93
PM42K0030	2K0R 2% MUL MR30	R7:18
PM42K2025	2K2R 2% MUL MR25	R56
PM42K7025	2K7R 2% MUL MR25	R2:19:34
PM43K0025	3K0R 2% MUL MR25	R12
PM43K3025	3K3R 2% MUL MR25	R29
PM48K2025	8K2R 2% MUL MR25	R94
PM510K025	10KR 2% MUL MR25	R26 8:57 8:68:73 9:80
PM511K025	11KR 2% MUL MR25	R10
PM512K5H8	12K5R 1% HOL H8	R38
PM515K025	15KR 2% MUL MR25	R5:46 7:52 3:88 9
PM518K025	18KR 2% MUL MR25	R45:51:65 6:91 5 6
PM520K025	20KR 2% MUL MR25	R1:16
PM528K755	28K7R 1% RES RC55	R36 7 9:59:60
PM556K025	56KR 2% MUL MR25	R33
PM6100K25	100KR 2% MUL MR25	R9:14:20 5:32:40 1:69:70 1 2 4 5 :85 6:97 8
PM6150K25	150KR 2% MUL MR25	R48:54:78:81 2 4:90
PM6560K30	560KR 2% MUL MR30	R77:83
RT54	THERMISTOR ITT RT54	TH1
RX6270KT4	270KR 2% ELC TR4	R35
CC15P60861	5P6F ERI 861/N470	C22
CC247P0801	47PF ERI 801/N470	C2 8:11 4 7:23
CC3150P831	150PF ERI 831/N330	C27 9:30 2:41 7 9
CE210U0GM	10UF 25V MUL 015	C25
CE3100UDM	100UF 10V MUL 016	C5
CE3220UFM	220UF 16V MUL 016	C33*P22 C50*P24
CF0U470LA2B	0.47UF 63V ASH A2B	C20 1:42
CF11U00LA2B	1UF 63V ASH A2B	C46:51
CP0U100PTFM	0.1UF 160V VIM TFM	C1 4 6 7 9:12 3 5:28:31:48
CP522K0PTFM	22KPF 160V VIM TFM	C39:40
CS45K60KA15E	5K6PF 50V MAT A15E	C18 9:35 6
DG4148	DIODE 1N4148	D1-11
PM3500R63P	500R SPL 63P	P5
PM41K0063P	1K0R SPL 63P	P6 8
PM45K0043P	5K0R SPL 43P T040	P2
PM510K043P	10KR SPL 43P T040	P1
PM510K063P	10KR SPL 63P	P7
SR240P	REED RELAY LPD240P OSM	RL1 2
VA3130E	INT CCT CA3130E RCA	IC1-6 8-12 6 7*REMOVE ONLY WITH TOOL
VA356TC	INT CCT UAF356TC FAR	IC13 4 5 8*REMOVE ONLY WITH TOOL
VA741CG	INT CCT CA741CG RCA	IC7*REMOVE ONLY WITH TOOL

ITEM NUMBER	DESCRIPTION	*------------- CIRCUIT REFERENCE
VFVCR3P	TRANSISTOR VCR3P FET	VT1 2
VT182PL	TRANSISTOR BC182PL	VT4-6
VT212PL	TRANSISTOR BC212PL	VT3
VS8P	IC SKT 703/4008 LOW/P	IC1-18
0C	C/B CAPACITY FACTOR	0
CF0U100NMKS3	0.1UF 100V VIM MKS3	C3:10 6:24 6:34 7
PLINK24	24 SWG TC LINK	R8 7
CAOMIT	CAPACITCRS OMITTED	C38:43-45
VP1A	TRANSITOR PAD TW1A	VT1 2
PAOMIT	POTENTIOMETERS OMITTED	P3 4

EXPLOS 27SSG5CC   CBA/ *CONTROL   DATE 10/07/82

ITEM NUMBER	DESCRIPTION	*------------ CIRCUIT REFERENCE
BC0832120	227/B *CONTPOL *	* B
PC71M0025	1M0P 5% MUL CR25	R1-11:33
PM41K0025	1K0P 2% MUL MR25	R37:41
PM43K3025	3K3P 2% MUL MR25	R43
PM43K9025	3K9R 2% MUL MR25	R49
PM46K8025	6K8R 2% MUL MR25	R42 7:52
RM48K2025	8K2R 2% MUL MR25	R40:53
PM510K025	10KR 2% MUL MR25	R25-7:35 6 9:48
RM522K025	22KR 2% MUL MR25	R44 5
PM533K025	33KR 2% MUL MR25	R38
PM547K025	47KR 2% MUL MR25	R46:50
PM556K025	56KR 2% MUL MR25	R51
PM6100K25	100KR 2% MUL MR25	R12-24 8:34
PM6180K25	180KR 2% MUL MR25	R54
CC3470P831H	470PF EPI 831/HIK	C1 2
DG4148	DIODE 1N4148	D1-57
PM42K0063P	2K0R SPL 63P	P3
PM45K0063P	5K0R SPL 63P	P2
PM510K063P	10KR SPL 63P	P1
PM525K063P	25KR SPL 63P	P4
SCSDC5	DIL SWITCH SDC5	SW1
VA741CG	INT CCT CA741CG RCA	IC10*REMOVE ONLY WITH TOOL
VD14002CP	INT CCT MC14002CP MOT	IC6 *REMOVE ONLY WITH TOOL
VD14585BCP	INT CCT MC14585BCP MOT	IC7-9*REMOVE ONLY WITH TOOL
VD4028AE	INT CCT CD4028AE RCA	IC1 2*REMOVE ONLY WITH TOOL
VD4029AE	CD4029AE RAC ONLY SSG	IC4*REMOVE ONLY WITH TOOL
VD4042AE	INT CCT CD4042AE RCA	IC3*REMOVE ONLY WITH TOOL
VD4069BCN	INT CCT CD4069BCN NSC	IC5*REMOVE ONLY WITH TOOL
VT182PL	TRANSISTOR BC182PL	VT1*
VS14L	IC SKT 703/4014 LOW/P	IC5 6
VS16L	IC SKT 703/4016 LOW/P	IC1-4 7-9
VS8P	IC SKT 703/4008 LOW/P	IC10
0C	C/B CAPACITY FACTOR	0
RAOMIT	RESISTORS OMITTED	R29:30 1 2
VP1A	TRANSITOR PAD TW1A	VT1

EXPLOS 27SSG5FM CPA/D *FM CORRECTION DATE 10/07/82

ITEM NUMBER	DESCRIPTION	*------------- CIRCUIT REFERENCE
BC0832128	227/F *FM CORR * *	B
PC71M0025	1M0R 5% MUL CR25	R57
PC72M2025	2M2R 10% MUL CR25	R32
PC73M3025	3M3R 5% MUL CR25	R47
PM3100R25	100R 2% MUL MR25	R39:55
PM41K0025	1K0R 2% MUL MR25	R40
PM42K4025	2K4R 2% MUL MR25	R23
PM45K6025	5K6R 2% MUL MR25	R1
PM46K8025	6K8R 2% MUL MR25	R56
PM510K025	10KR 2% MUL MR25	R3:20 1 4 6:41 2 8:54
PM515K025	15KR 2% MUL MR25	R4
PM520K025	20KR 2% MUL MR25	R25
PM522K025	22KR 2% MUL MR25	R2
PM525K025	25KR 2% MUL MR25	R13-18:22
PM547K025	47KR 2% MUL MR25	R44
PM6100K25	100KR 2% MUL MR25	R34-37:49-53 8 9
PM6180K25	180KR 2% MUL MR25	R19
PM6220K25	220KR 2% MUL MR25	R38:43
PX550KUT5	50KR 2% ELC TR5	R5-12
CC222P0YD	22PF ERI YD/NPO	C3
CC247P0YD	47PF ERI YD/N750	C6
CC510K0861	10KPF ERI 861T/25	C8 9:22 3
CE210U0GM	10UF 25V MUL 015	C19:20
CF0U100RMKC4	.1UF 250V WIM MKC4	C17 8
CF0U470LA2B	0.47UF 63V ASH A2B	C21
CF11U00LA2B	1UF 63V ASH A2B	C11 2
CF547K0NMKS	47KPF 100V 20% MKS4	C13 6
CP510K0PTFM	10KPF 160V WIM TFM	C2
CT222U0GC	22UF 25V TAG22/25	C1
DG4148	DIODE 1N4148	D1-10
PM45K0063P	5K0R SPL 63P	P1
PM510K063P	10KR SPL 63P	P2
VA3140E	INT CCT CA3140E RCA	IC2*REMOVE ONLY WITH TOOL
VA356TC	INT CCT UAF356TC FAF	IC10 4*REMOVE ONLY WITH TOOL
VA741CG	INT CCT CA741CG RCA	IC15*REMOVE ONLY WITH TOOL
VD200CJ	INT CCT DG200CJ	IC13*REMOVE ONLY WITH TOOL
VD4001CN	INT CCT CD4001CN NSC	IC20*REMOVE ONLY WITH TOOL
VD4011BE	INT CCT CD4011BE RCA	IC16 9*REMOVE ONLY WITH TOOL
VD4013BE	INT CCT CD4013BE RCA	IC21*REMOVE ONLY WITH TOOL
VD4016CN	INT CCT CD4016CN NSC	IC1 3-6*REMOVE ONLY WITH TOOL
VD4066CN	INT CCT CD4066CN NSC	IC8:11 *REMOVE ONLY WITH TOOL
VD4069BCN	INT CCT CD4069BCN NSC	IC7:12 *REMOVE ONLY WITH TOOL
VD4070	INT CCT CD4070BE RCA	IC18*REMOVE ONLY WITH TOOL
VD4093BCN	INT CCT CD4093BCN NSC	IC17*REMOVE ONLY WITH TOOL
VS14L	IC SKT 703/4014 LOW/P	IC1 3-9:11-13 16-21
VS8P	IC SKT 703/4008 LOW/P	IC2:10 4 5
0C	C/B CAPACITY FACTOR	0
CF0U100NMKS3	0.1UF 100V WIM MKS3	C4 5:14 5
VD4024BE	INT CCT CD4024BE NSC	IC9*REMOVE ONLY WITH TOOL
CAOMIT	CAPACITORS OMITTED	C7:10

ITEM NUMBER	DESCRIPTION	*------------- CIRCUIT REFERENCE
7NU0832233	TOP COVER	
7NU0832234	BOTTOM COVER	
7SM1047	FOOT	
HW3114003	EXTRACTOR TOOL	
HC0011	COAX LEAD	
HC0010	COAX LEAD	
TK1947	MAINS LEAD WITH MOULDED CEE SOCKET	
TG13A3	PLUG 13A PIN UK MAINS	
TR201A	BNC ADAPTER	
TR5020	BNC ATTENUATOR 20DB 50 OHM	

R.F. BOX HARDWARE

HW0832180	R.F. BOX LID	
HW0832181	R.F. BOX	
HR26R61	RECEPTCAMLOCK	
HR27S51	WASHER CAMLOCK	
HR260011	STUD CAMLOCK	
ZC15U10	CHOKE 15µH	
ZF1115	FERRITE BEAD	
CD41K751214	FEEDTHROUGH 1K75pF (56 OFF)	
CD41K00N54	FEEDTHROUGH 1K0pF (5 OFF)	
RM45K6025	5K6 2% MR25	R9
CE41K00IW	1KµF 35V	C1
CF0U680R352	0.68µF 250V	C2
YH8035	R.F. GASKET	
TR50675	BULKHEAD FEEDTHROUGH	