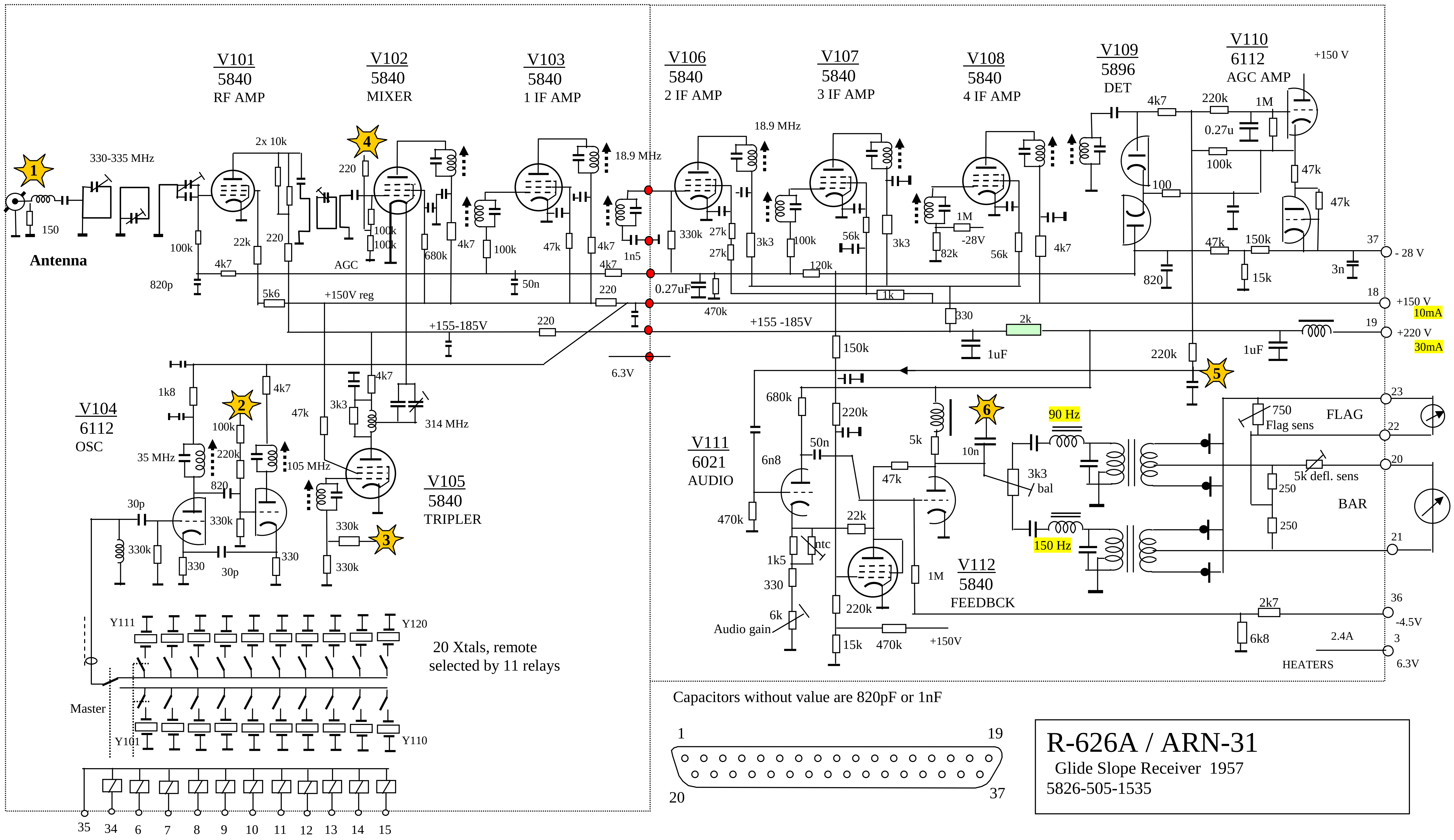
More information on page 2



Capacitors without value are 820pF or 1nF

1 19
20 37

R-626A / ARN-31

Glide Slope Receiver 1957

5826-505-1535

Instrument Landing System

Two pairs of transmitter antennas at the end of the runway give guidance for a safe landing.
One pair, called Localizer, is for the horizontal deviation, the other for vertical deviation called Glide Slope.
The two Localizer transmitters have the same VHF frequency, and the Glideslope transmitters have the same UHF frequency. Back in 1956, there were 20 channel pairs, now there are 40.
Within each pair, one transmitter is amplitude modulated with 90Hz, the other with 150Hz.

ARN-31 system

The ARN-31 receiver set dates from 1956, using subminiature tubes and some early germanium diodes. The system has two receiver boxes and a common power supply. The receivers differ only in the frequency band.

R-625/ARN31 Localizer Rcvr 108.1 -111.9 MHz
R-626/ARN31 GlideSlope Rcvr 329.3 -335.0 MHz
PS?? /ARN31 Power supply
ID250/ARN LOC/GS course deviation indicator

This document describes the glide slope receiver.

R-626 / ARN-31 Glide Slope receiver

General

The receiver is a single conversion superhet, with four IF stages at 18.9MHz. The bandwidth is approx. 140kHz (-6dB) or 200kHz (-30dB), adequate for the 300kHz channel spacing as used in 1957. Nowadays, the spacing is 150kHz, and two adjacent channels if present at one airport are received at the same time.

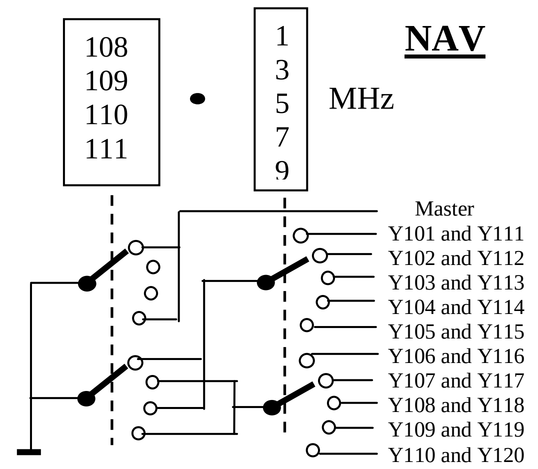
Local oscillator

A crystal oscillator near 35 MHz is tripled twice to get the LO frequency, which is 18.9MHz below the signal frequency. For each of the 20 channels, there is a crystal, organized in two banks of 10 crystals. Ten relays each select two crystals, one in each bank. The eleventh relay (master) selects the bank.

The relay circuit is completely floating. Each relays has 800 ohm coil resistance, so with a maximum of 2 relays, the 27Vdc bus consumption is 70mA

Control panel

The NAV-COMM control panel for the ARN-31 has two rotary switches, indicating the VHF frequency for the Localizer.

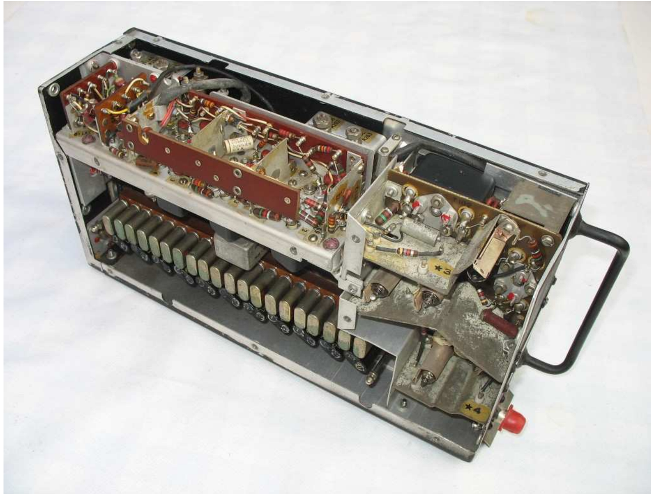


The switch interconnections were obtained from the crystal frequencies inserted in my ARN-31.
The following combination were found :

Bank 1	Localizer MHz	GS Xtal MHz	Glideslope MHz
Y101	108.10	35.0888	334.70
Y102	108.30	35.0222	334.10
Y103	108.50	34.5555	329.90
Y104	108.70	34.6222	330.50
Y105	108.90	34.4888	329.30
Y106	111.10	34.7555	331.70
Y107	111.30	34.8222	332.30
Y108	111.50	34.8888	332.90
Y109	111.70	34.9555	333.50
Y110	111.90	34.6888	331.10
Bank 2			
Y111	110.10	35.0555	334.40
Y112	110.30	35.1222	335.00
Y113	110.50	34.5222	329.60
Y114	110.70	34.5888	330.20
Y115	110.90	34.6555	330.80
Y116	109.10	34.7222	331.40
Y117	109.30	34.7888	332.00
Y118	109.50	34.8555	332.60
Y119	109.70	34.9222	333.20
Y120	109.90	34.9888	333.80

The frequency pairing is rather odd, the position of the 20 crystals in the glide slope unit seems nearly random.
Alternatively, the crystals can be inserted in the same order as their frequency, i.e. Y101 = 34.4888 MHz etc. This sequence corresponds to another control panel, the C –

The 20 crystals can be seen in this picture.
The receiver is rather small, only 31x15.5 x9 cm.



IF amplifier.

The IF amplifier has 4 stages at 18.9 MHz. The tuning drifts less than 30 kHz, whatever the supply voltage or ambient temperature is. The 6dB bandwidth is 140 kHz. The gain remains max from zero up to 20 µV input (-80dBm) at the antenna connector. With more input, the audio amplitude at TP5 remains constant at 1.5Vpp

Detector and delayed gain control

The dc voltage at TP5 is +12V without signal. With increasing signal level, this voltage drops gradually, until at –80dBm input, TP5 becomes negative, and the AGC starts to function.

Typical AGC voltages are :

Input signal	Voltage at AGC to first IF ampl
- 80dBm or less	-1.21 V
- 60 dBm	-3.26
- 40 dBm	-4.20
- 20 dBm	-4.80
0 dBm	-5.48

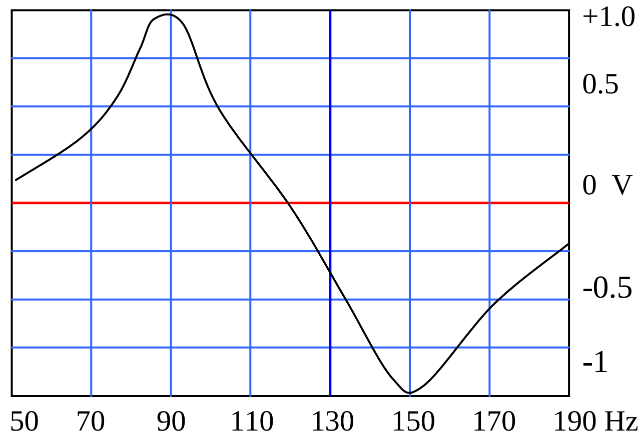
The minimum input signal is -100 dBm (2 µV), producing 40mVpp signal at TP5, twice the noise amplitude.

90Hz and 150Hz filters

The output of the R626/ARN31 drives the horizontal (Glideslope) bar, and the corresponding flag in the course deviation indicator.
Both the bar and the OFF flag are driven by a 1kΩ moving coil. The sensitivity is +/- 0.3 mA for full deviation, with 1mA allowed overdrive.

The output circuit is fully floating. The received audio signal is filtered with two LC filters at 90Hz and at 150Hz, corresponding to the modulation frequencies as used. The ac signal from each filter is rectified with an early diode array from Transitron with gold-bonded germanium diodes dated 1954.

Plotted below is the output voltage at pin 20 versus pin 21 with sufficient RF input signal , as a function of the modulation frequency:



Glideslope bar

The ARN31 can drive one or two indicators in parallel at 1V at either 90Hz or 150Hz between pin 20 and 21, pin 20 being positive at 90Hz. The output drops proportionally with the received RF signal when this is less than 22 µV .

Flag

The flag alarm is also a 1 kΩ moving coil instrument , requiring at least 0.3mA before the "OFF" disappears
The flag is driven between pin 23 (+) and pin 22

Power supply

The external power supply is probably common for the Localizer and Glideslope receivers.. Each requires
+ 220V @ 40 mA max
+150V regulated at 10mA
- 28V @ 2mA bias
6.3V ac @ 2.4A