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**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**

- Frequency range: 108.1 - 111.9 MHz
- Power supply: ID250/ARN

**R-626/ARN31 Glideslope**

- Frequency range: 329.3 - 335.0 MHz
- Power supply: ID250/ARN

This document describes the glideslope 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 280kHz if 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. 10 relays each select two crystals, one in each bank. The eleventh relay (master) selects the bank.

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

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

The following combination were found:

<table>
<thead>
<tr>
<th>Bank</th>
<th>Localizer MHz</th>
<th>GS Xtal MHz</th>
<th>Glideslope MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y101</td>
<td>108.10</td>
<td>35.0855</td>
<td>334.70</td>
</tr>
<tr>
<td>Y102</td>
<td>108.30</td>
<td>35.0222</td>
<td>334.40</td>
</tr>
<tr>
<td>Y103</td>
<td>108.50</td>
<td>34.5555</td>
<td>329.90</td>
</tr>
<tr>
<td>Y104</td>
<td>108.70</td>
<td>34.6222</td>
<td>330.50</td>
</tr>
<tr>
<td>Y105</td>
<td>108.90</td>
<td>34.4888</td>
<td>329.30</td>
</tr>
<tr>
<td>Y106</td>
<td>111.10</td>
<td>34.7555</td>
<td>331.70</td>
</tr>
<tr>
<td>Y107</td>
<td>111.30</td>
<td>34.8222</td>
<td>332.30</td>
</tr>
<tr>
<td>Y108</td>
<td>111.50</td>
<td>34.8888</td>
<td>332.90</td>
</tr>
<tr>
<td>Y109</td>
<td>111.70</td>
<td>34.9555</td>
<td>333.50</td>
</tr>
<tr>
<td>Y110</td>
<td>111.90</td>
<td>34.6888</td>
<td>333.10</td>
</tr>
</tbody>
</table>

**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
- 0 dBm -4.80

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

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 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 Transistor 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:

**Gildeslope 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 Ω 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 - 25V @ 2mA bias 6.3V ac @ 2.4A

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**Control panel**

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