ARC-45 UHF and 1st IF
14-2-2016 kb
ARC-45 Circuit description

Frequency selection
The ARC-45 supports 12 channels out of the 1750 that is possible in 100kHz steps between 225 and 400MHz. Each of the 12 channels can be set -for the whole MHz with a crystal of frequency $F_1$, and for the tenth-MHz with a peg sliding over 10 positions. The relation of $F_1$ to whole MHz is:
$$F = 8x F_1 + 23.49 \text{ (MHz)}$$
There are 175 possible $F_1$ crystals; 12 are mounted in the turret.

The first IF amplifier is tuned to 23.49...24.39 MHz. With the second local oscillator at 20.51...21.41 MC in ten 0.1MHz steps, the second IF amplifier operates at a fixed 2.98 MHz. In order to make the transmit frequency equal to the receive frequency, a side step oscillator is used, with frequency $F_{ss}= 11.745 ...12.195$ MHz in 50kHz steps. The transmit frequency is:
$$F = 2x (4xF_1 + F_{ss})$$

Channel selection mechanism.
On the SB328 control, Channel is a 4-wire code:

<table>
<thead>
<tr>
<th>Pin</th>
<th>CH 1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EE</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FF</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

x= connected to ground, blank=interconnected. For instance channel 5 is selected when DD and EE are interconnected, and FF and HH are tied to ground.

An unidirectional dc motor in the ARC-45 drives 3 things via electromagnetic clutches:
- First, the turret is set to the Channel.
- The turret has 12 crystals with trimmers for the first LO, pegs to select the tenth MHz, and a lever to select one of 12 variable capacitor (varco) discs;
- Then, the 2x6 section varco in the UHF part rotates until the disc arrived at the notch. Then S4 is set to release step c)
- This moves the first IF varco, and a selector switch until the program peg interrupts the motor. This selects the crystals for the sidestep and second LO. The whole tuning can take 7 seconds.

Transmitter audio circuits.
The microphone signal is pre-amplified in the SB-329 cockpit-based panel, ending with a cathode follower. The cathode circuit is completed in the RT-295A. A 400kHz signal from the dynamotor is added as long as the TONE button on the control panel is pushed. The resulting audio signal is clipped and fed to the modulator, a balanced class B amplifier. Without signal, the current is zero. The 7W peak output modulates the anode voltage of the RF pencil triodes.

Transmitter RF part
The superimposed signals from the crystal oscillators at 4x F1 and from the sidestep oscillator enter the mixer V6. The product at 112-200 MHz is filtered out and amplified in V3 and V4. The frequency is doubled to 225-400MHz in the pencil triode V3, and applied to the final amplifier with pencil triodes V1 and V2. The CW output is 2W.

Receiver RF part
Starts with a low noise triode 6AJ4, followed by a band filter to reject the mirror frequency. After mixing with twice the first local oscillator signal we get the first IF.

First IF between 23.49 and 24.39 MHz in one stage is situated in a closed box, together with a selector switch for the 10 crystals of the second local oscillator, and 10 crystals for the sidestep oscillator.

Second IF at 2.98 MHz has 3 stages. The bandwidth is 50kHz. Automatic gain control is applied to grid 3 of the first two stages.

Detector, noise limiter and AGC.
The IF signal is rectified and large peaks are limited in V3. The resulting audio signal is 2Vpp at 60% AM. Tube V1 is an oscillator at 30kHz, producing a symmetrical squarewave of 60Vpp on the anode of the AGC tube V2. With higher received signal, tube V2 conducts more in the positive half, and the complete squarewave shifts down, making the average value more negative, up to -3.3V for AGC-1 and -5V for AGC-2

Audio amplifier
The audio amplifier has a triode preamplifier V2 and a balanced output amplifier (V3 and V4) to produce 10Vpp (50mW) into 150 $\Omega$ load. Only one grid of the output stage is driven, the other is grounded for signals. Because the triodes have a common cathode resistor, the sum of the anode currents is constant. If one rises, the other must decay. The preamplifier stage has a high gain, so the heavy feedback makes the input a virtual ground for signals:
- Two audio signals are fed to this input: the signal from the AM detector, via the audio adj potmeter (in receive mode only), or
- The transmitted signal (in transmit only)

Squelch
The audio summing point can be grounded by the squelch tube (V1), which silences all audio as long as its grid voltage is above 2V below the cathode voltage (normally +1.5V). Without input signal, the voltage from the AGC line is 0V, so the squelch tube conducts, blanking the signal. With 4V input, the AGC drops to -2V, and the squelch tube blocks, so the signal is passed. During transmit, the squelch tube is blocked by a large negative signal from the transmitter to enable the side tone. There is no switch to overrule the squelch function.

Plate and negative supply
The external dynamotor supplies the +150V and +300V voltages. The automatic gain control (AGC) provides its own negative voltage.

Heater circuit
All 32 heaters are 6.3V types, and series/parallel connected for 4x 6.3 = 25.2V, consumption is 1.7A. A 0.82$\Omega$ series resistor matches the heater circuit to the 27.5Vdc aircraft dc bus.

TR relay
This relay has a coaxial part for the antenna and 3 leave contacts to switch the 300Vdc, 150Vdc, and one to reduce its own coil current once energized. This boost contact should open as last. Otherwise the other contacts will not close fully. Adjustment of the timing of these contacts is rather tricky.

Testconnector and test switch
On the front side behind the door is a testconnector and a small toggle switch. This switch operates the TR relay, and hence the transmitter. When the door is closed, the switch returns to the receive position. The testconnector connects to the AN/ARM-8 test set, an analog voltmeter with a 20-way switch at its input. This unit is for the ARC-44 but also adequate here for most adjustments.

Fan
The fan has a 3-phase winding intended for 27Vac, 400Hz, and makes 9000 rpm. Further data see ARC-44.

Versions
All versions including the control box and the dynamotor were made by Bendix Radio Corp. The RTA-45 was also made by Telefunken.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Original</th>
<th>Improved</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>ARC-45</td>
<td>RTA-45</td>
</tr>
<tr>
<td>Year</td>
<td>1958</td>
<td>1960</td>
</tr>
<tr>
<td>Transceiver</td>
<td>RT 295</td>
<td>RT 295A</td>
</tr>
<tr>
<td>Control</td>
<td>SB-328</td>
<td>CNA-45A</td>
</tr>
<tr>
<td>Dynamotor</td>
<td>DY 107</td>
<td>DY 107</td>
</tr>
<tr>
<td>Test unit</td>
<td>ARM-8</td>
<td>TEP 44/45</td>
</tr>
</tbody>
</table>

The differences are minor, and the parts are fully exchangeable. The original transceiver had a flat top, exactly as the ARC-44. The tenth-MHz was set with 12 thumbwheels. Output was 1W.

The improved version had a stepped top, the front most side higher than the ARC-44. The tenth-MHz is selected with pegs on the turret. Output was 2W.

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The UHF transceiver has 32 tubes and no semiconductors (in 1960!)
3x 5636 0.15A separated g3
2x 5647 0.15A
1x 5675 0.15A pencil triode RCA
5x 5719 0.15A
3x 5840 0.15A beam power triode
1x 5899 0.15A
1x 5902 0.45A beam power
2x 6005 0.45A beam power (EL90)
2x 6205 0.15A
2x 6110 0.15A double diode
1x 6112 0.3 A double triode
1x 6AJ4 0.225A

White LED to illuminate MC dial added in 2016