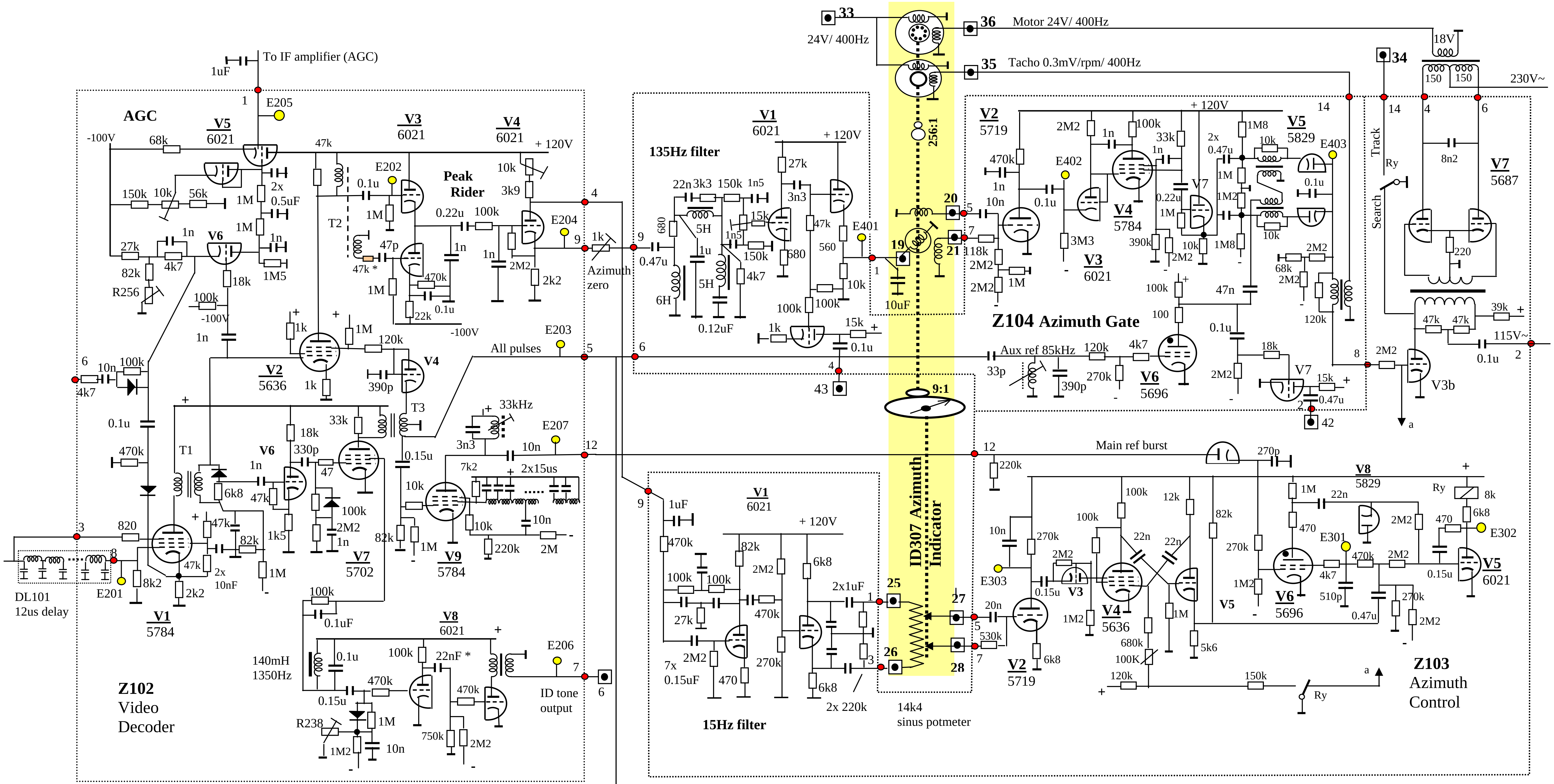


■ One of the pins in the main 45-pin connector on rear of chassis

● Connector pin on module Zxxx

*) improvements over standard RT220B

ARN-21B Video and Azimuth Circuit Diagram

17-3-2007

RT220B Azimuth circuits

This part of the circuit diagram covers the video processor and the 15Hz and 135Hz circuits that drive the azimuth indicator ID-307 or eq.

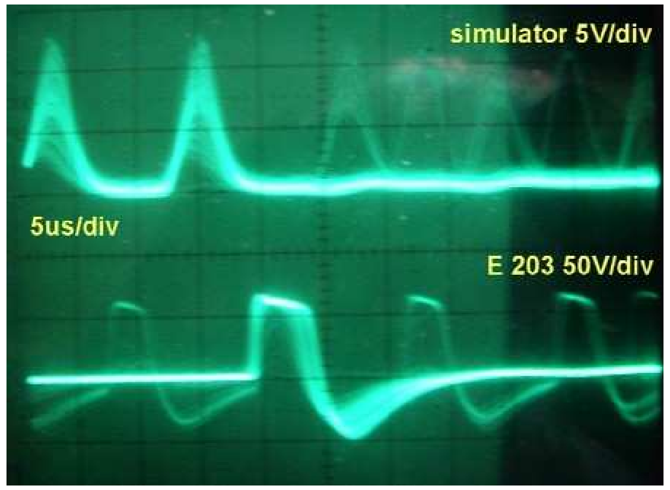
<u>Module Z102</u> - Video processor

The video processor :

- Is only sensitive to double pulses with 12µs spacing,
- keeps the video amplitude constant using the AGC ;
- Interconnects the tops of the 3µs pulses to reconstruct the typical amplitude modulation as caused by the rotating tacan beacon antenna ;
- Shapes all accepted pulses for the range circuits ;
- detects the main,- and auxiliary reference pulses;
- detects the beacon ID information.

Doublepulse filter

The video signal from the IF is applied both direct and delayed by 12µs to the video processor. Coincidence only occurs for double pulses spaced by 12µs and results in an output pulse E203 approx. 18µs after the first pulse in the video signal at testpoint E201. Note the 1:3 amplitude variation of the video pulses, but the fixed height (and width) of the output pulse at E203.



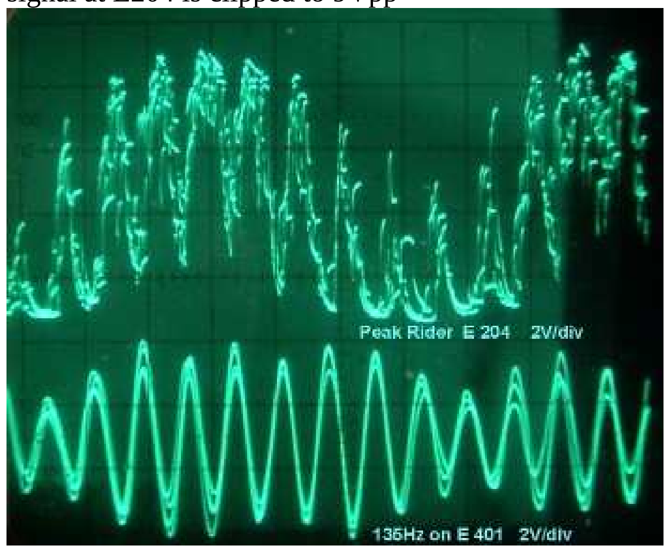
AGC circuit

All accepted pulses with variable height are fed to the AGC circuit, which is sensitive only for the highest peak per 100ms which shall be 12Vp when the AGC is properly adjusted. Any deviations are integrated with approx. 1 sec time constant, and drive the AGC line of the IF strip. In practice, large fluctuations of the RF signal strength in a few 100ms still give a fairly constant video amplitude.

Peak rider

All received pulses give 3µs wide V2-anodecurrent pulses of up to 10mA. Each pulse charges the main inductance (50mH) of transformer T2, and drives the lower triode V3 in full conduction, making the peak rider capacitor (1 nF) to drop by some 20V. A*fter* this pulse, the main inductance produces a voltage over swing proportional to the current pulse. This overswing drives the V3 upper triode, charging the peak rider capacitor by cathode follower action.

Directly on the 1nF peak rider capacitor there is a nice sample and hold waveform with the 15Hz and 135Hz components clearly visible. The cathode follower V4 however clips this waveform both in the top - by grid current- and in the bottom - at zero current-, so the signal at E204 is clipped to 9Vpp



This peak ride method makes large errors when the pulses have less than 50µs spacing, like at the main and auxiliary reference bursts. During these bursts, the peak rider is disabled via V4 to g3 of V2.

The grid current of the lower triode loads the upswing of the transformer. This makes the peakrider output dependant of the –random - interpulse time. To prevent extra noise, it helps to put 47k in series with the 47pF to the grid of V3b

Main reference detector

The main reference signal is a burst of 12 pulses with 30µs spacing, transmitted when the main lobe of the beacon antenna points East. In all RT220 types, a circuit around V9 detects the main ref burst. Detection is enhanced with a 15µs delay line, which starts with a negative pulse from grid-2 of V9, then is reflected back from the shorted end, and arrives 15µs later as a *positive* pulse on grid-3. If this pulse coincides with the next received pulse, then the anode circuit, tuned at 33kHz, gets a current pulse. In 8 pulses, the signal on E207 grows to 200Vpp !

Auxiliary ref detection

This is a train of 12 pulses with 12µs spacing, transmitted by the beacon each time a minor lobe passes East. There are 8 auxiliary ref bursts, the ninth is the main ref burst. The double-pulse detector passes all pulses, and the train is detected by a tuned circuit at 85 kHz, situated on Z104.

Beacon ID detection.

Every 37 seconds, the beacon transmits its identification (3 or 4 characters) in Morse code. The dots and dashes replace the normal echos and squitter by a 1350Hz double pulse signal, with 100µs spacing between the pulses. In the RT220, the 1350Hz component is filtered out of the received valid pulses, amplified to a 50Vpp square wave (still 1350Hz) and fed via the control panel to (originally) a headset.

Bearing indication is a closed loop servo process. A motor rotates the pointer and two phase shifters such that the 15Hz and 135Hz output signals of these phase shifters coincide with the reference pulses.

<u>Module Z103</u> - 15Hz circuits

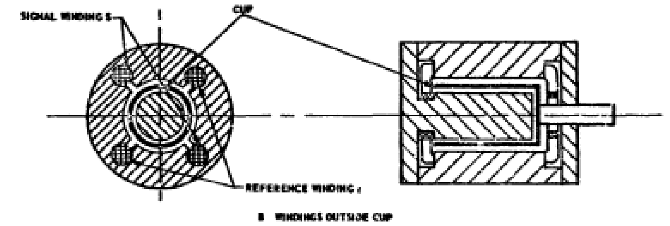
The 15Hz component is filtered out of the peak rider signal with a double-T filter and applied to the "sinus" pot meter in the bearing indicator. This pot meter has a continuous circular (wound) track with two taps, and two wipers spaced 90 degrees. When the taps are supplied with +1V and –1V dc, the wipers would produce the sine and cosine of the angular position of the potmeter. When a proper RC is connected to the wipers, the potmeter becomes a 15Hz continuous phase shifter.

The result is amplified to an asymmetric squarewave, - a pulse of 30 degrees wide-, the 15Hz acceptance window. Thyratron V6 checks whether this pulse at E301 coincides with the main ref or not. If not, the bearing indicator motor runs anticlockwise at full speed (20sec per full turn) and the pulse at E301 shifts with it until they coincide. Then the relay Ry turns on, and the fine bearing circuit Z104 takes over. Also, the 15Hz acceptance window is widened to 40 degrees to prevent fall back.

The servo amplifier V3b forms a bridge circuit, fed by 115V/400hz ac. When the “resistance” of V3b is 39k, the bridge is balanced, and the motor does not run. With a lower or higher resistance, the motor runs forward or backward.

Tacho feedback

The Indicator has a drag-cup type tacho attached to the motor. Around the drag cup is a reference winding, supplied by 24V, 400Hz, and a signal winding, producing 3V,400Hz at full speed, exactly in-phase or opposite phase, depending on direction, or no voltage at all when stationary.

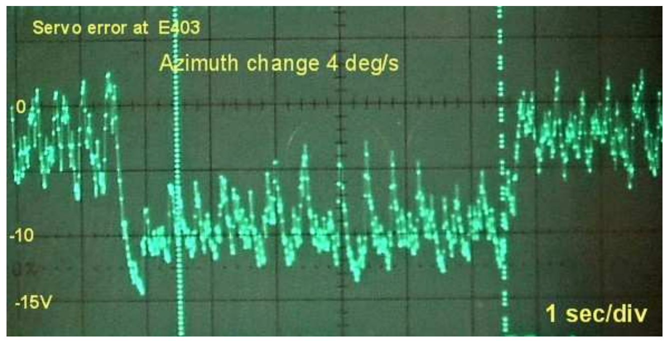


<u>Module Z104</u> - 135Hz circuits

The 135Hz component is filtered out of the peak rider signal. There is some 15Hz amplitude modulation on it due to clipping in cathode follower V4.

The 135Hz sinewave is phase shiofted inside the bearing indicator instrument with a resolver running at 9 times the speed of the pointer. The inductance of the armature is compensated by a large capacitor. The output of the resolver is over-amplified to a square wave, and sampled at the moment of the aux ref pulse. The result is the servo error signal at testpoint E403 as shown below. This error signal can be interpreted as the "speed" error and is first compared to the real speed of the pointer as measured by the tacho. The error of this second comparison drives the motor.

In this recording, the aircraft made a 24 degree turn around the beacon in 6 seconds, so a change in bearing of 4 deg/s



The normal voltage on testpoint E403 of -3V changes to -10V, while the pointer rotates over 24 degrees. When the bearing no longer changes, the servo error stabilises again at -3V. In the recording, 2.5 periodic fluctuations per second are visible, indicating a closed servoloop bandwidth of 2.5Hz. The trace is made up of 7ms tiny horizontal parts as a result of the sample and hold circuit.