

Yaw channel operating principle SFIM 85T31 Automatic Pilot

A. Synchronisation

Figure 1

Synchronisation takes place when the yaw channel is not engaged

- relay "K2" isolates yaw series actuator "705C1" from the A.P. channel.
- relay "K1" in rest position transfers HSI "43F" information to the yaw channel.

Any variation in the heading detected by the HSI "43F" results in creation of two voltages at "T1" output:

- one proportional to the sinus of the heading deviation,
- the other proportional to cosinus of the heading deviation.

Each of these two voltages is adapted then saved.

As heading variation takes place at the same time on the input channels and on the memories, a zero-voltage to synchronizer output is obtained.

Therefore, during the synchronisation function, the yaw channel recopies the heading modifications so as to maintain the output voltage at 0 V.

B. Automatic stabilisation - Current heading holds

Automatic stabilisation occurs when the yaw channel is engaged :

- Relay "K1" cut the connection between the sinus and cosinus input channels and their respective memories. The latter saves the heading reference acquired at the time of stabilisation function engagement.
- Relay "K2" establishes the connection between the yaw control channel and the yaw control actuator "705C1".

For any heading deviation, the sinus and cosinus input channels receive the deviation voltages which are adapted, demodulated, filtered and added to the saved values.

A continuous voltage proportional to the deviation between the heading saved and the current heading is obtained at the synchroniser output.

These deviations are added to that of the airspeed channel which delivers a voltage proportional to the heading variation.

This information is transmitted by means of a progressive clipping which authorises this information to be transmitted to the inputs of the yaw control actuator power amplifier. The yaw control actuator acts on the control linkage downstream so as to counter the heading angle deviation.

The action exerted on the flight control is proportional to the control voltage, the helicopter returns to its reference heading, the deviation information tends to be cancelled at the output of the differential amplifiers for the sinus and cosinus channels.

C. Cruise function (turn coordination)

This function is automatically engaged when the speed is above 50 kt (90 km/h) and the lateral slope becomes greater than 5°, it is maintained as long as the yaw angular speed remains $> 1.5^\circ/\text{s}$.

During this action, the yaw channel is permanently supplied by the diverted signal supplied by the indicated airspeed channel, through a signal depending on the side slip coming from the transverse accelerometer and the sinus in order to cancel side slip to prevent flight with a significant lateral attitude.

These voltages are transmitted to the yaw actuator power amplifier which acts on the control linkage downstream so as to counter the yaw side slip.

D. Capture and indicated heading holds

Capture and selected heading hold takes place when:

- The roll channel and the yaw channel are engaged. The pilot has selected a heading with a heading index on HSI "43F".
- The HDG function is engaged.

The heading deviation from the HSI "43F" and the deviation between the heading index of the HSI and the heading is processed by an electronic circuit (filtering and forming of the signal) through a softener circuit which limits the speed order and absolute value.

As the roll channel is in automatic stabilisation function, relay "K1" is working and the actuator amplifier output voltage acts on the yaw control actuator "705C1". This acts on the downstream control linkage in order to counter the heading deviation (with a maximum lateral attitude of approximately 18° and a maximum angular air speed of 5°/s). The roll attitude reference is frozen to 0.

Moreover, the yaw channel permanently receives a diverted signal supplied by the air speed channel (signal depending on the yaw angular air speed obtained by diverting the heading). This signal grants a very good stability to the helicopter around the yaw axis. Another signal depending on the side slip coming from the transverse accelerometer and the sinus cancels the side slip (to prevent flying with a significant lateral attitude).

E. Change of heading "C. AFF" (indicated heading) function

To change heading, the pilot must:

- either cut the function, change heading and if he would like to hold the heading automatically again, set the heading index of the horizontal situation indicator on the new selected heading;
- or (normal use), display the new heading desired with the heading index of the horizontal situation indicator by preventing a deviation greater than 180° with respect to the position of the helicopter from being indicated.

The helicopter automatically takes up the new heading.

i NOTE

Avoid indicating heading deviations greater than 180°. If during heading indication the deviation becomes greater than 180°, the helicopter will reverse its turn direction in trying to reach its new heading by the shortest path.

F. Control wheel steering

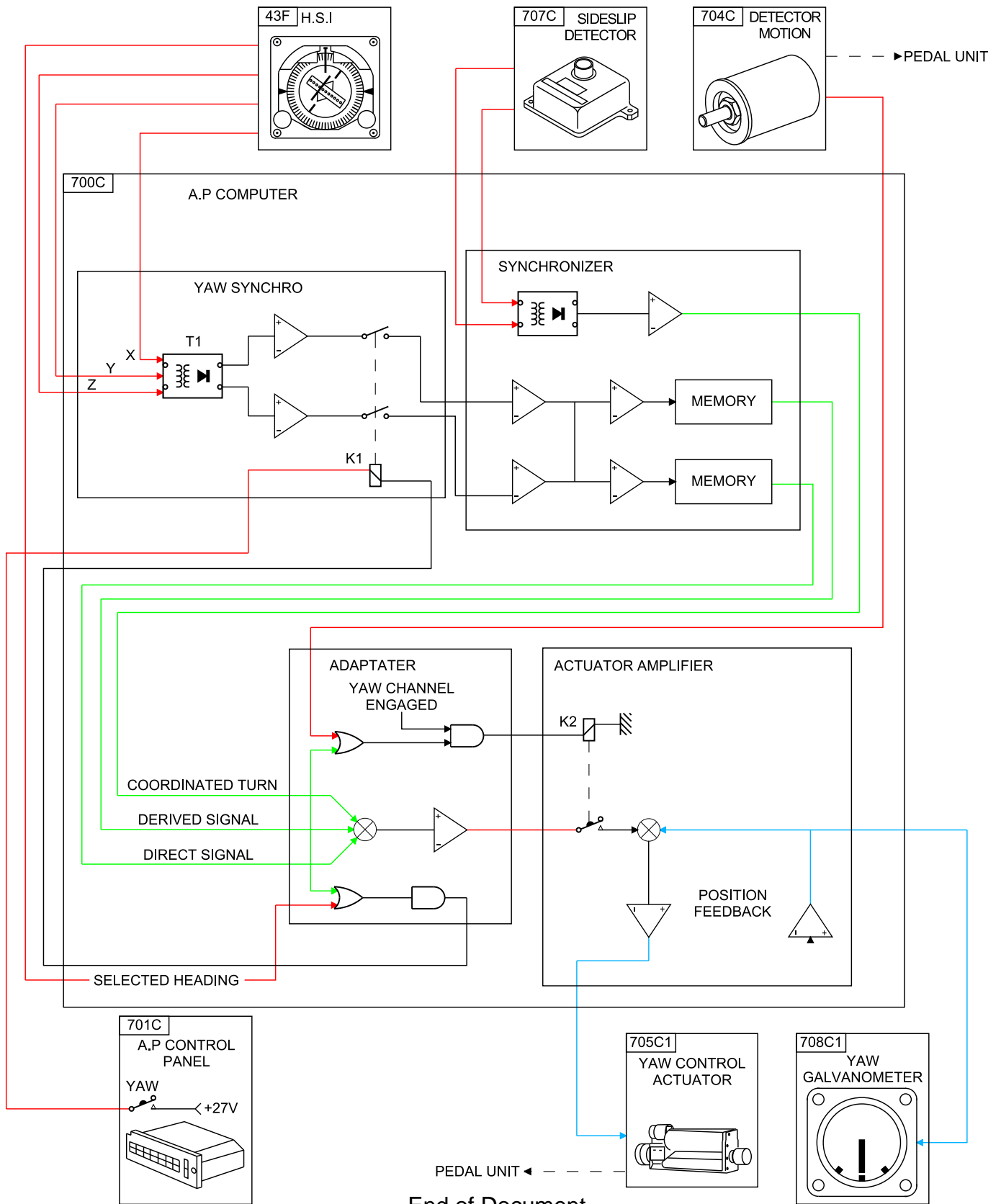
The pilot must adjust the yaw pedal in order to modify the heading reference. As soon as a movement of the pedals is detected by the motion sensor in series in the control linkage, the yaw channel is synchronised and yaw control actuator “705C1” is re-centred.

In order for the yaw channel to return to stabilisation function and stabilise a new heading, two conditions must be fulfilled:

- No movement of the pedal.
- Yaw angular speed is less than 1.5°/s.

This channel arrangement makes it possible to prevent any jerks and provides good stop precision for the new heading.

Figure 1: SFIM 85T31 Automatic Pilot - Yaw channel operating principle



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