Roll channel operating principle
SFIM 85T31 Automatic Pilot

A. Synchronisation

Figure 1

Synchronisation takes place when the roll channel is not engaged consequently “K1” relay and the “Q2” contact are in rest position.

The “K1” relay isolates the “705C3” control actuator with respect to the A.P. channel.

The “Q2” contact isolates actuator amplifier from the + 27 Vdc voltage.

For any variation in the roll attitude, the vertical gyro “57C” delivers an error voltage “E1” to the input comparator “C2”. The error voltage “E1” is demodulated, filtered then applied to two lanes:

- the position lane which delivers a voltage “E2” proportional to the attitude deviation,
- the airspeed lane which delivers a voltage “E3” proportional to the attitude variation speed.

These two voltages are added and filtered before being applied to the adaptation circuit of the power amplifier.

On the direct lane a voltage “E4” supplied by the synchroniser is added to voltage “E1”. As these two voltages are of different signs, the output voltage of the control channel tends to be cancelled.

B. Automatic stabilisation

Automatic stabilisation takes place when the roll channel is engaged, consequently relay “K1” and contact “Q2” are in working position:

- relay “K1” establishes the connection between the A.P. channel and the control actuator “705C3”. Contact “Q2” powers the A.P. actuator amplifier with +27 V.

The pilot does not exert any limited authority stick release, trim, trim + stick, manoeuvres:

- consequently contact “Q3” isolates the synchroniser. The latter saves the attitude reference acquired at the time of channel engagement.

For any roll angle deviation with respect to the reference, the roll channel demodulation circuit connected to the vertical gyro delivers an error voltage which is applied:

- on the position lane then to the actuator power amplifier,
- on the switching and comparison logic of the roll trim control board.

The control actuator “705C3” acts on the control linkage downstream so as to counter the roll angle deviation.

If the amplitude of the error voltage signal becomes greater than the set threshold, the control actuator “705C3” is activated based on the sign control logic.

In both cases, as the action on the flying control is proportional to the control voltage, the helicopter returns to its reference attitude:

- the error voltage at output of the synchroniser tends to be cancelled.

The roll diverted voltage from the sum of speed lane voltage added to the position lane voltage ensures dynamic stabilisation of the helicopter flight.

C. **Control through artificial loads**

Control through artificial loads is carried out when the roll channel is engaged and the pilot wants to impose manoeuvres on the helicopter and then return to the initial configuration:

- to this end, the pilot activates the cyclic stick in roll.

As the load release, TRIM, BEEP + stick controls are not activated (contact “Q3” is open), the synchroniser saves the initial roll reference.

The action of the stick adjusts the control linkage and thus helicopter flight.

Helicopter stability during the manoeuvre is ensured by roll diverted voltage “E3” (diverted lane) added to roll deviation voltage “E2” (direct lane).

When the pilot releases the stick, it is returned to its initial position by the artificial load spring and the helicopter returns to its initial flight configuration.

D. **Stick release function**

As the roll channel is in stabilisation function, the pilot has the “TRIM REL” push button located on the cyclic grip to quickly modify the cyclic stick anchoring point and the attitude reference. Triggering this push button controls release of the artificial loads of the trim actuators “706C2”.

During this action:

- The roll channel is engaged, the pitch series actuator “705C3” is controlled by the A.P. Relay “K1” is in working position.
- Slow synchronisation of the memory (contact “Q3” is closed).

  The pilot moves the anchoring point of the stick thus modifying the attitude reference.

  At the same time, the control linkage slaved to the stick movement controls helicopter manoeuvre.
- helicopter stability is ensured by the voltage delivered by the diverted lane,
- inhibition of the TRIM warning.

When the pilot releases the push button, the TRIM actuators “706C2” are engaged. The artificial load feel reappears.

The roll channel stabilises the helicopter flight around the reference imposed by the new cyclic stick anchoring point position.

The pilot also has the possibility to release the artificial loads by the “EFF” push button located on the control panel. The pushbutton allows the artificial loads to be kept disengaged. Operation is the same as activating the cyclic stick push button.

E. **Manual trim function (BEEP-TRIM)**

As the roll channel is engaged, the pilot can impose roll manoeuvres to the helicopter by action on the four-way selector.

Adjusting this selector controls the roll trim actuator depending on the pressure direction (forward or backward) which slowly modifies the angle reference.

During this action:

- the contact “Q3” is placed in rest position by the TRIM logic (synchronisation of the roll channel),
- synchronisation of the roll channel inhibits the automatic roll trim function,
- inhibition of the TRIM warning by the combining logic controlled by the TRIM logic,
- the control actuator “705C3” is not cut-off from the A.P. channel (relay “K1” is in work position),
- the control linkage slaved to movement of the trim actuator “705C3” controls stick movement and helicopter manoeuvre.

During manoeuvre, helicopter stability is ensured by the diverted voltage (“E3”) delivered by the airspeed lane.

When the pilot releases the four-way selector, the roll channel is stabilised (Contact “Q3” opens) and stabilises helicopter flight on the new imposed references.

F. **BEEP - TRIM plus stick function**

As the roll channel is in stabilisation function, the pilot may impose roll manoeuvres to the helicopter by a simultaneous action on the cyclic stick through the artificial loads and on the four-way selector.

During this action:

- the contact “Q3” is placed in rest position by the TRIM logic (synchronisation of the roll channel),
- synchronisation of the roll channel inhibits the automatic roll trim function,
- the TRIM warning is inhibited by the combined logic controlled by the TRIM logic and the micro-switch of trim actuator “706C2” opens,
- the control actuator is not cut off by the A.P. channel (relay “K1” is in work position).

The action exerted by the pilot on the stick results in movement of its anchoring point, therefore in modification of the roll attitude reference.

The control linkage slaved to lever movement, controls helicopter manoeuvre.

Adjusting the four-way selector controls movement of the trim actuator depending on the pressure direction which brings the actuator neutral towards the new anchoring point.

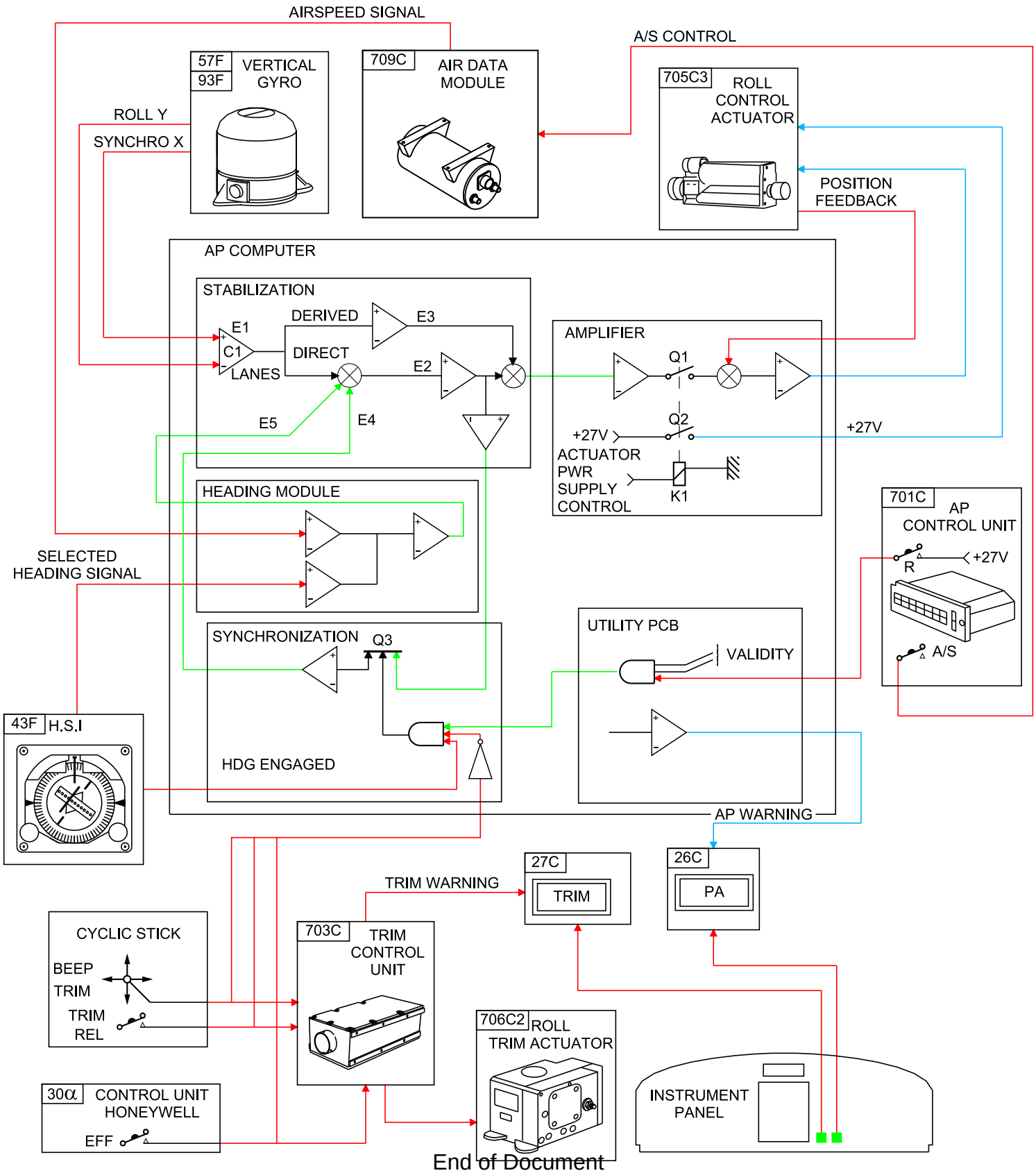
During manoeuvre, helicopter stability is ensured by the diverted “E3” voltage delivered by the speed channel.

When the pilot releases his load on the stick, and the “BEEP - TRIM” button, the roll channel is stabilised, the helicopter flight is stabilised on the roll reference imposed by the new position of the stick anchoring point.

G. **A.P. recentring function (TAC)**

Activating the “A.P.TAC” button on the control panel recentres the roll TRIM actuator.

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



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