Mikoyan-Gurevich MiG-29 (9-12)

Note:
On schemes are marked only used elements.

List of abbreviations

ADF	Automatic direction finding
ADI	Attitude director indicator
AFCS	Automatic flight control system
COC	AOA limiter system
FCU	Feel control unit
HDD	Head-down display
HSI	Horizontal situation indicator
HUD	Head-up display
IFF	Identification Frien of Foe
SPO	Radar homing and warning receiver
WCS	Weapon control system

Instrument panel

2.Combined AoA / G meter UAP-7.

3. Button Alarm Central - KSTs-2.

4. Control panel ILS-31.

5. The indicator of Direct Vision - IPV.

7. Switch of an operating mode of headlights.

8. Airspeed indicator US-1600.

10. Attitude director indicator KPP.

11. Vertical velocity, turn and slip indicator DA-200.

13. Control panel of the unit release flares.

14. Radar altimeter RV-21.

15. Tachometer ITE-2.

16. ISTR4-2 fuel indicator.

17. Display of "Ekran" system.

18. Telelight panel.

20. Gear retract/extract lever.

21. Altimeter UV-30-3.

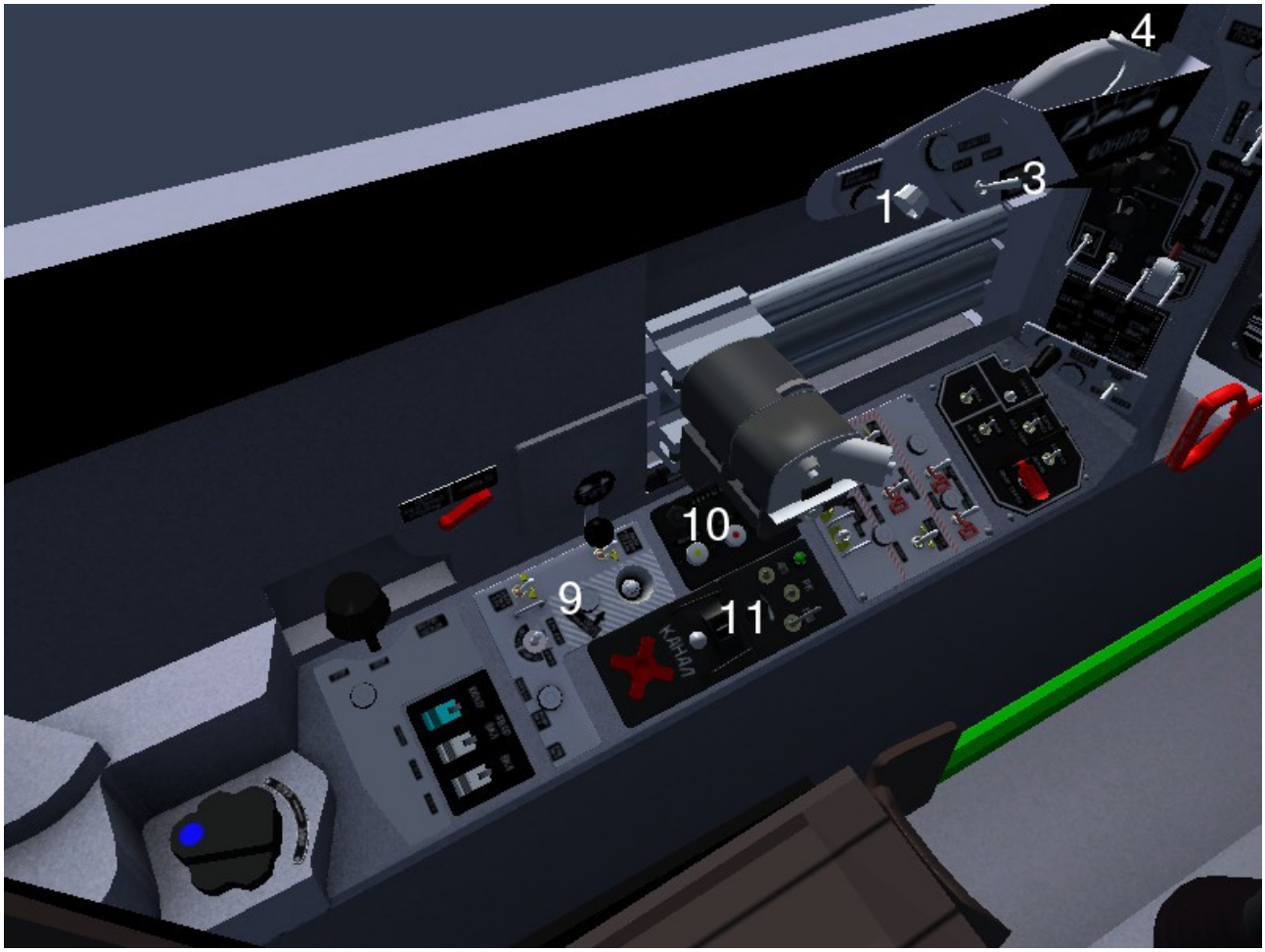
22. Horizontal Situation Indicator PNP-72-12.

23. TAS and M number indicator UMS-2.5.

24. Flares remainder indicator

25. Exhaust gas temperature indicator ITG-1.
26. Autopilot control panel.
27. Rudder trim switch.
28. Langing system signal panel IP-52.
29. Button «СОГЛАС. М. КУРСА» and switch «КУРС ЗАДАН».
30. Clock AChS-1.
31. Combined oxygen indicator IKZh-1.
32. Combined pressure indicator IKG-1.
33. Ramp position indicator IPK.
34. RHWS indication panel.
35. Control panel navigation system.
37. Voltmeter
38. Lever select Pitot.
39. Brake pressure indicator M-2A

Left panel



1. Button of deploy of a drag parachute.
3. Telelight panel «CANOPY LOCK»
4. Canopy control handle.
9. ARU control panel.
10. Flaps control panel.
11. Control panels R-862 radio station

Right panel

1. Handle of emergency dumping of a canopy.

2. Mechanical indicator of closing of a cockpit.

4. Switch heating Pitot tube, glass canopy.
Text «ОБОГРЕВ ПВД СТЕКЛА»

5. Fwd lighting control panel.

6. Aft lighting control panel.

7. Electric power panel.

11. ARK-19 adf control panel.

16. Engine start panel.

19. System power panel.

20. Telelight panel.

21. Control panel of the right board.

Control stick

1. AFCS MODES OFF button.
2. Trim button.
3. Levelling button.
4. Click zone of the CL tank jettison button.
5. Click zone of the AP cut-out lever.

Instrument equipment

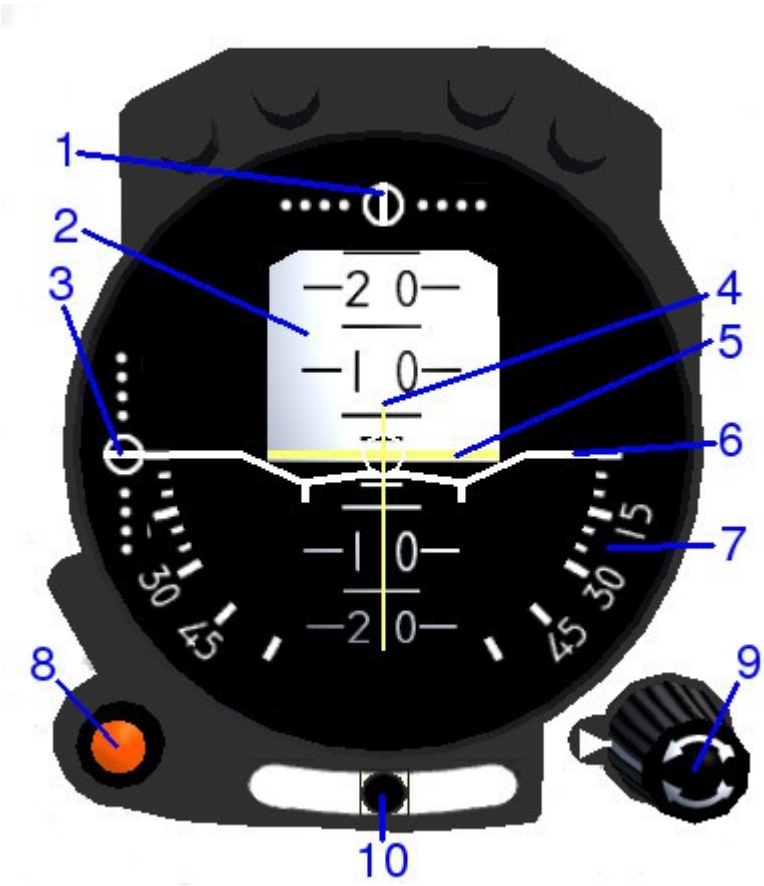
HUD

Mode «Navigation»

1. Speed.
2. Reference point of change of speed.
3. Course scale.
4. Motionless reference point of a course.
5. Altitude.
6. Pointer roll.

7. Motionless cross hairs.
8. Target mark..
9. Scale roll.
10. Scale pitch.
11. Artificial horizon line.
12. Range up to waypoint.

Attitude director indicator KPP



1. Plank position of the course.
2. Scale pitch.
3. Plank position vertically.
4. Director of a needle roll.
5. Director of a plank pitch.
6. A silhouette of the aircraft.
7. Scale roll.
8. Button-lamp «Арретир»
9. Handle of set of zero horizon.
10. Sliding indicator.

PNP-72-12

1. Distance counter.
2. Flag of failure of the SN calculator or one attitude and heading reference system
3. Index of the counter of a current course.
4. Counter of the course set.
5. Combined scale drift angle and azimuth radio station.
6. Scale of a current course.
7. Arrow course angle.

8. Arrow of the course set.

9. Flag course.

10. Flag glideslope.

11. Arrow of a deviation from an equal-signal zone of a course.

12. Arrow of a deviation from an equal-signal zone of a glideslope.

13. Deviation scale from an equal-signal zone of a course and glideslope.

14. Knob of the course set

Combined AoA / G meter UAP-7.

1. Scale of an angle of attack.

2. Scale overload.

3. Arrow of an angle of attack.

4. Index of the limit reached overload in flight.

5. Arrow of an overload.

6. The button of reset of an index of the limit reached overload in flight.

Airspeed indicator US-1600

1. Speed scale.

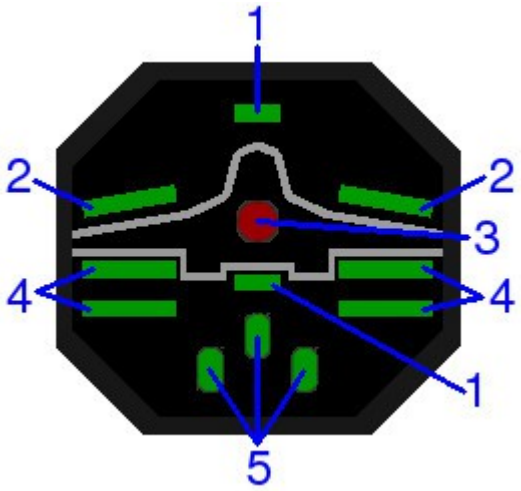
2. Needle

3.Speed over 1000 km/h sign indicator.

Altimeter UV-30-3

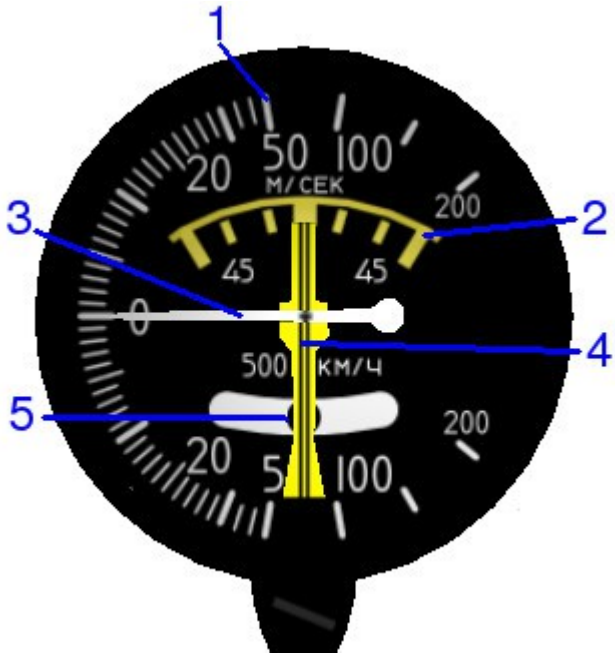
1. Scale of measurement of altitude in meters (external).
2. Altitude counter.
3. Needle big.
4. Needle small.
5. Scale of measurement of altitude in kilometers (internal).
6. Counter P_0.
7. Index of counting of the tenth shares of mm hg.
8. Handle of input of P_0.

Langing system signal panel IP-52.



1. Lamps of release of speedbrake.
2. Lamps of release of LERX.
3. Lamp of intermediate position of the landing gear.
4. Lamps of release of flaps.
5. Lamps of the landing gear.

Vertical velocity, turn and slip indicator DA-200.

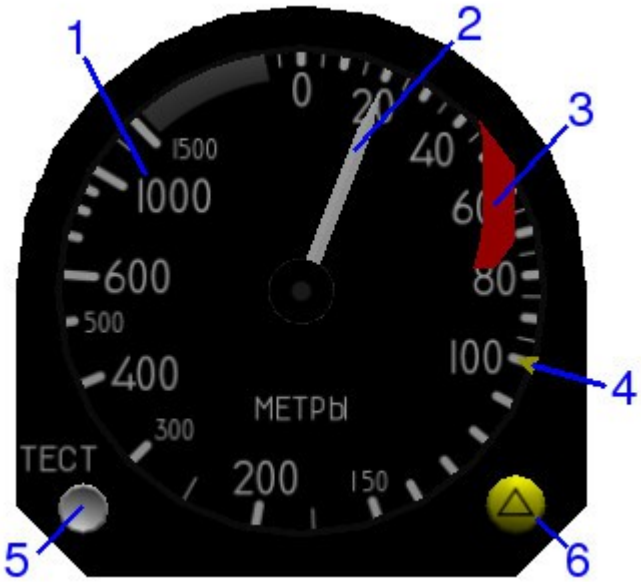


1. Scale of vertical speed.
2. Turn scale.
3. Needle of the index of vertical speed.
4. Needle of the index of turn.
5. Sliding indicator.

TAS and M number indicator UMS-2.5

1. The combined scale of M number and true speed.
2. Needle wide (M number).
3. Needle narrow (true speed).

Radar altimeter RV-21.



1. Altitude scale.
2. Needle.
3. Flag. *Drops out at malfunction of the radio altimeter and radiometric altitude more than 1500 meters.*
4. Index of "the dangerous altitude"
5. Button of check of RV-21.
6. Handle set a «dangerous altitude».

Tachometer ITE-2

1. Scale
2. Needle of the left engine.
3. Needle of the right engine.

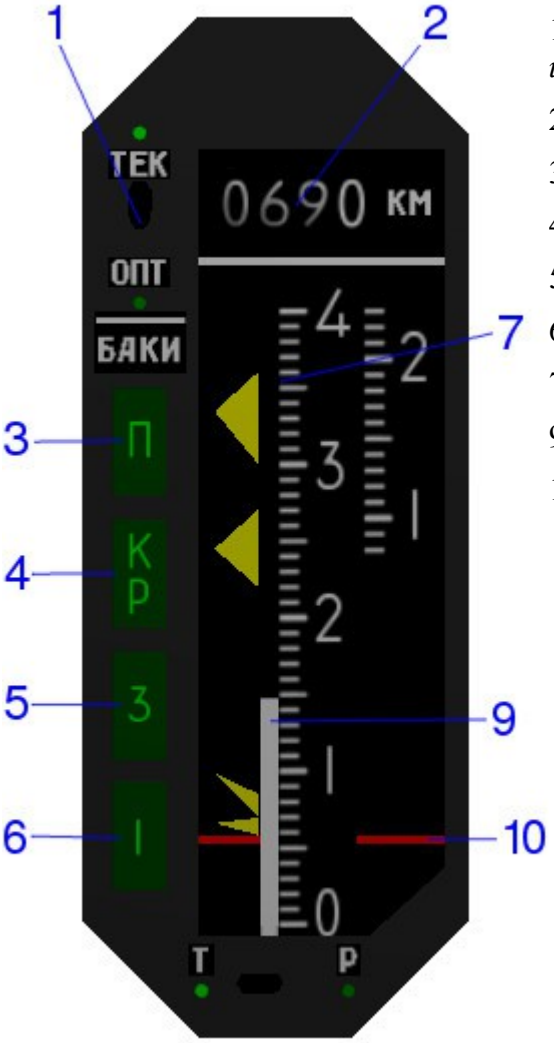
The indicator of Direct Vision - IPV

1. Switch «МЕТКА-ТРАССА». *Not used.*
2. Switch «ТАКТ-ДУБЛ». *Not used.*
3. Handle of regulation of brightness

Combined pressure indicator IKG-1.

1. Scale of the main hydraulic system.
2. Scale booster hydraulic system.
3. Scale of the main air system.
4. Scale of the emergency air system.
5. Needle of the main hydraulic system.
6. Needle booster hydraulic system.
7. Needle of the main air system.
8. Needle of the emergency air system.

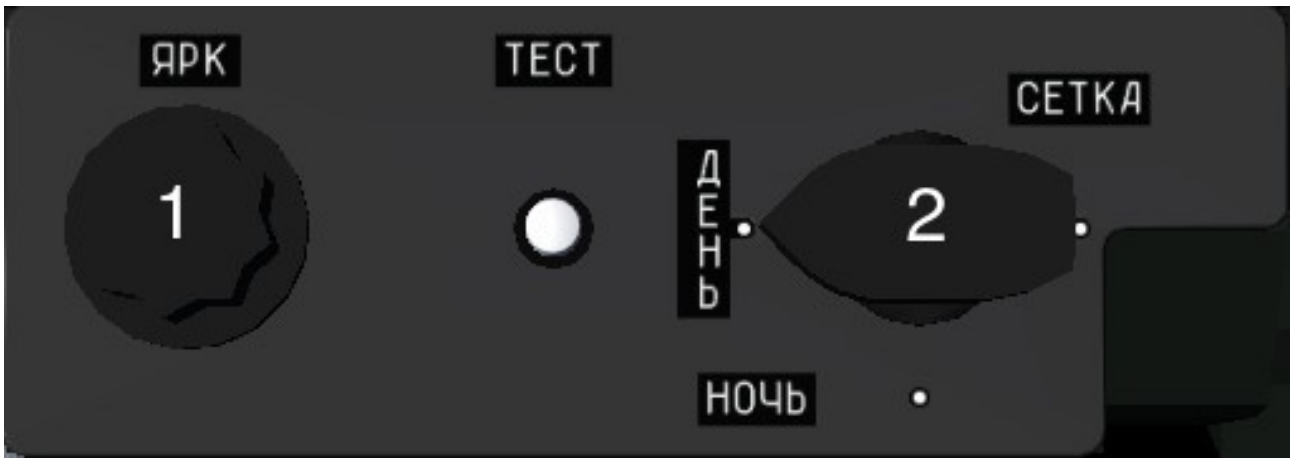
ISTR4-2 fuel indicator.



1. Switch of a mode of calculation of range of flight. *Not used.*
2. Counter of range of flight.
3. Lamp indicator of consumed of drop tank.
4. Lamp indicator of consumed of wing tanks.
5. Lamp indicator of consumed of tank №3.
6. Lamp indicator of consumed of tank №1.
7. Scale of amount of fuel.
9. Movable index of amount of fuel.
10. Line-pointer emergency remaining fuel.

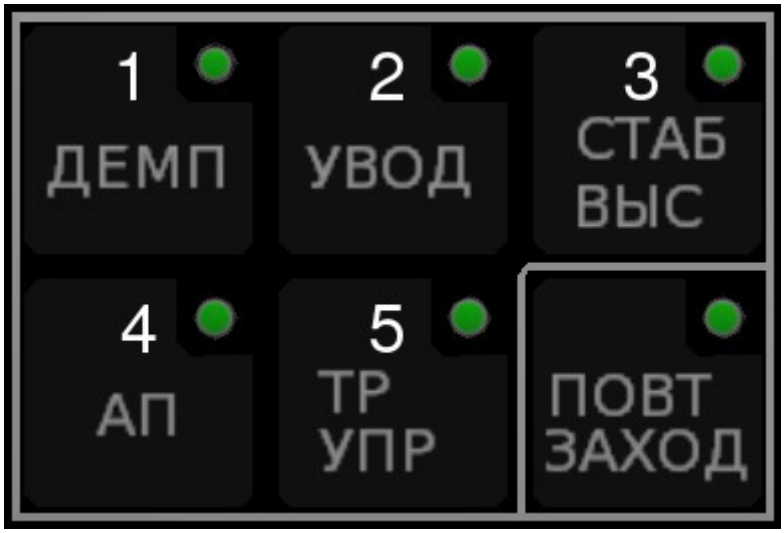
Control panels

ILS-31 control panel



1. Brightness control knob.
2. Knob of switching of modes.

Autopilot control panel

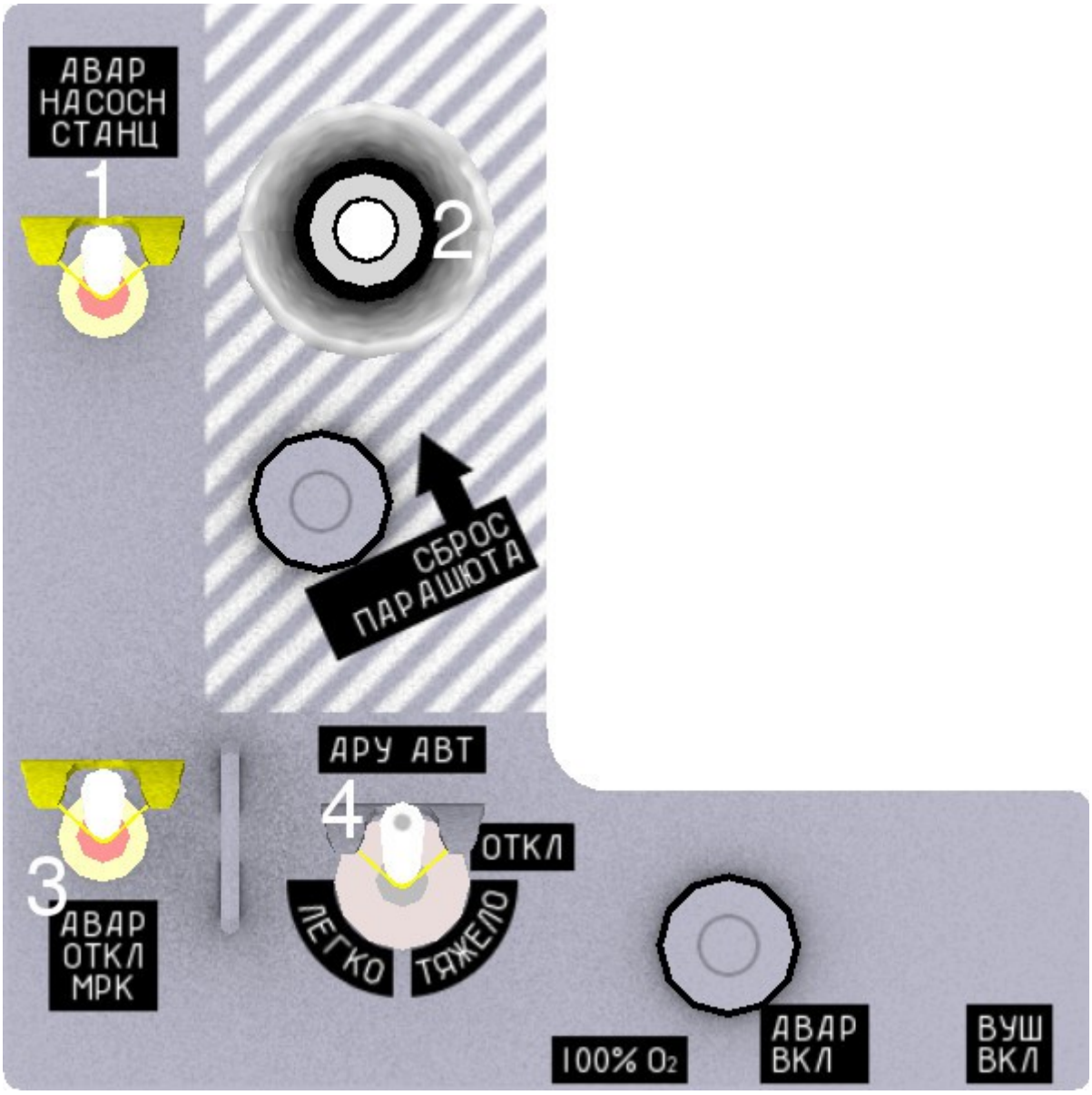


1. Damper button.
2. Auto recover button.
3. Altitude hold button.
4. Atitude hold button.
5. Trajectory control button.

Flaps control panel

1. Button extend flaps to position «Landing».
2. Button extend flaps to position «Take-off».
3. Button retracting the flaps.

ARU control panel

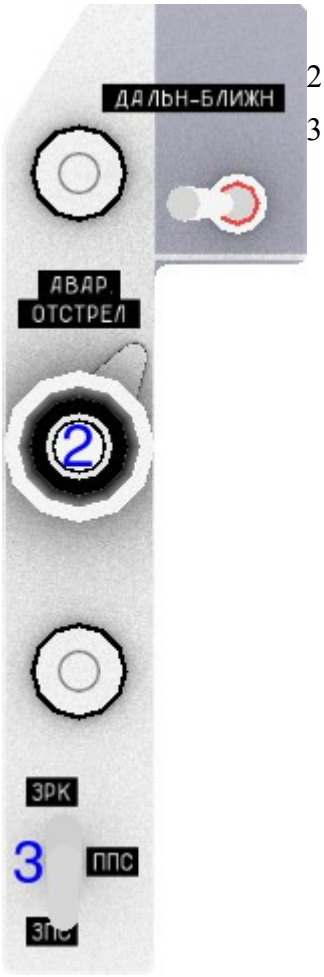


1. Switch of emergency pump station.
2. Button of droping of a parachute.
3. Emergency switch of the mechanism of a turn of wheels.
4. Switch of an operating mode of ARU.

Control panels R-862 radio station

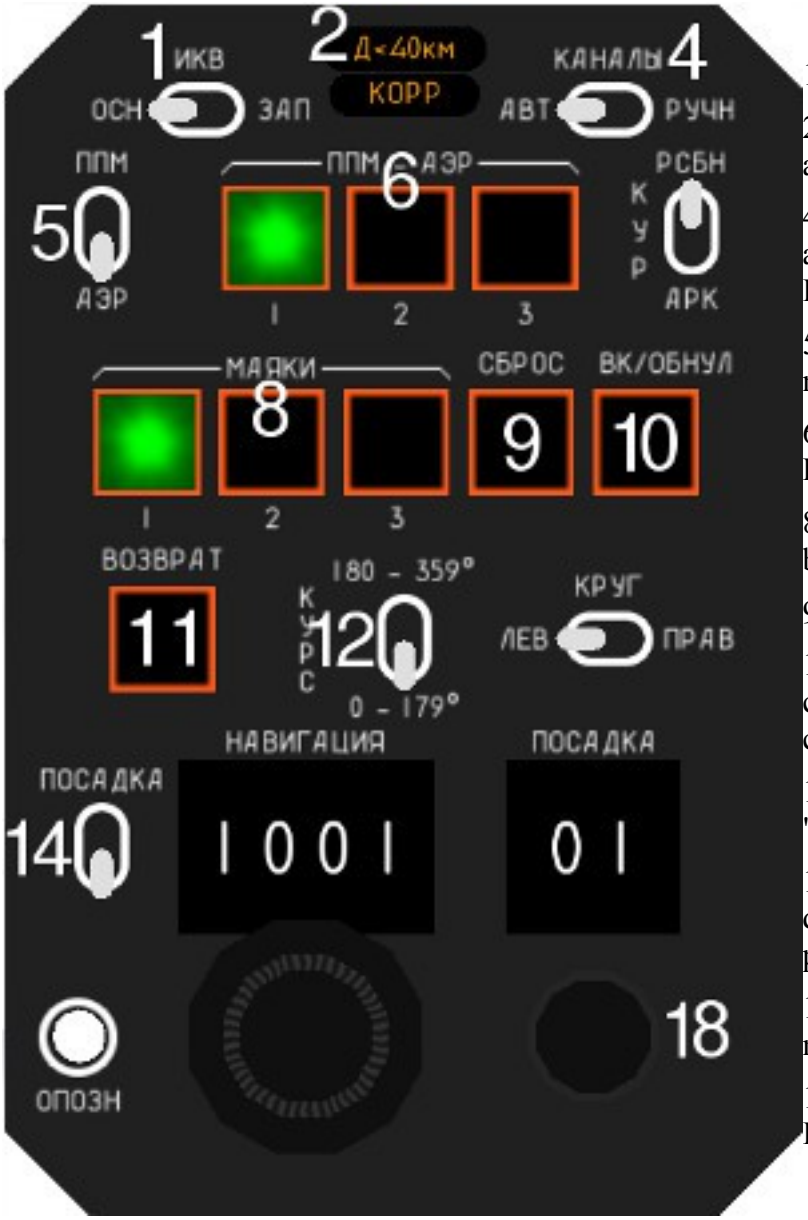
1. Knob of regulation of volume.
2. Channel number..
3. Channel selector.

Control panel of the unit release flares



2. Button emergency release of flares.
3. Switch type of threat.

Control panel navigation system



1. Switch AHRS.

2. Board Д<40 - to warn of the approach to the next waypoint.

4. Switch of a select of automatic/manual input of RSBN and ILS channels.

5. Switch of a select of type navigation point.

6. Button-lamps of a select of number PPM/AER.

8. Button-lamps of a select of number beacon.

9. Button-lamp «Сброс».

10. Button-lamp of input parking courses/corrections of the calculated coordinates.

11. Button-lamp mode on / off "Return".

12. The switch of a select of the direction of approach runway of the programmed airfield of landing.

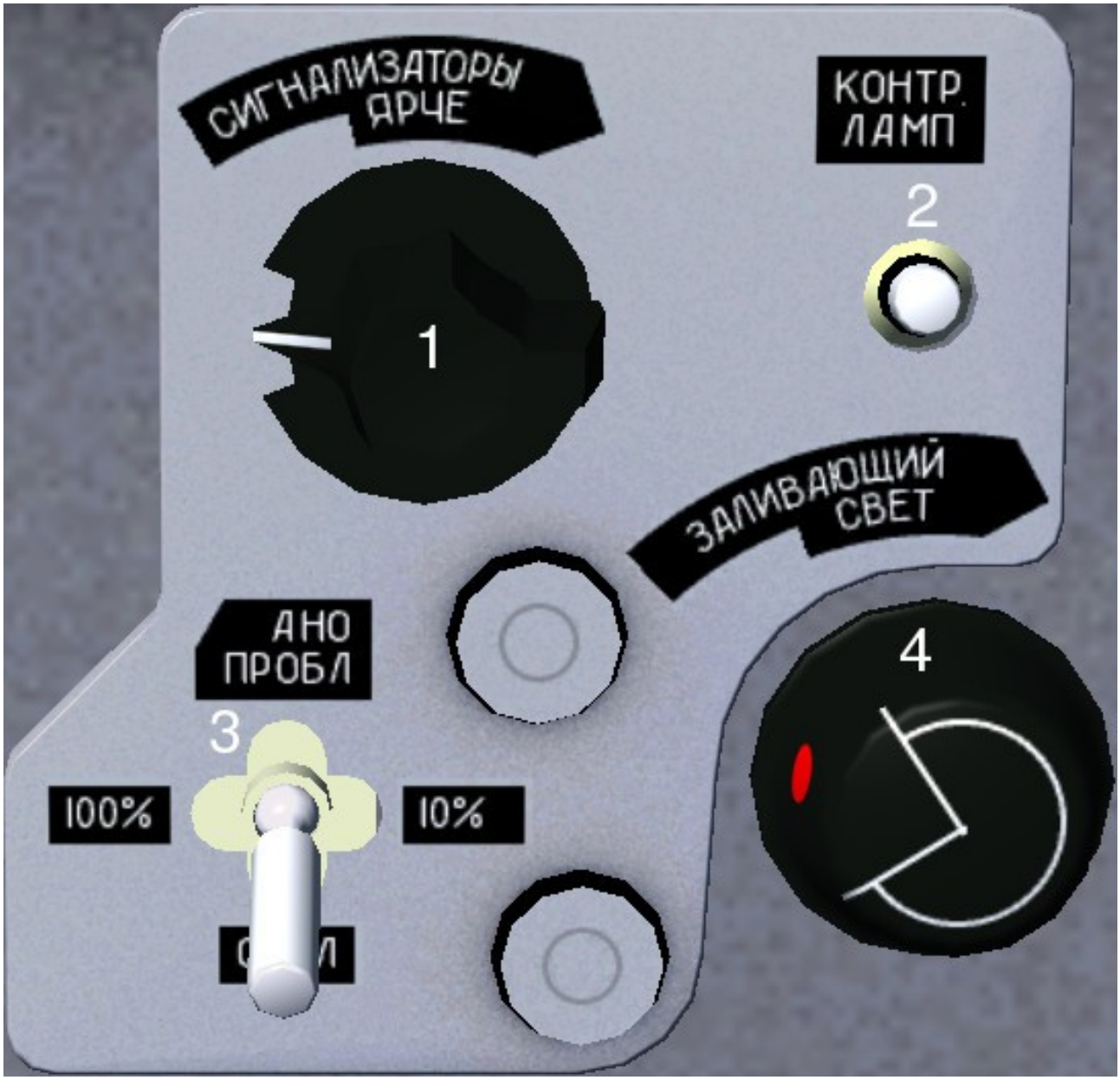
14. Switch manually activate the mode "Landing".

18. Handle of manual input of the ILS channel.

ARK-19 adf control panel

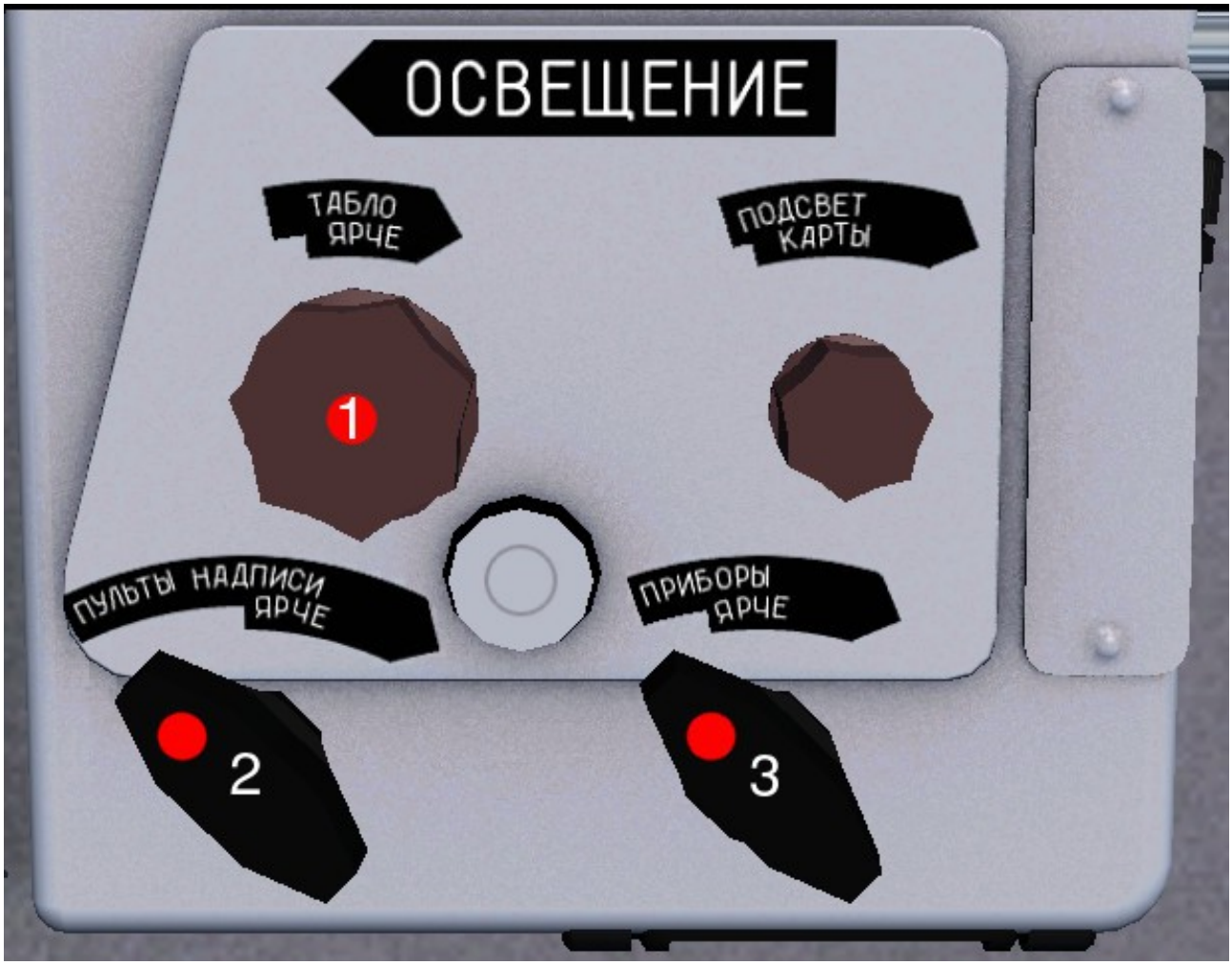
1. Channel selector..
2. Knob of regulation of volume.

Fwd lighting control panel



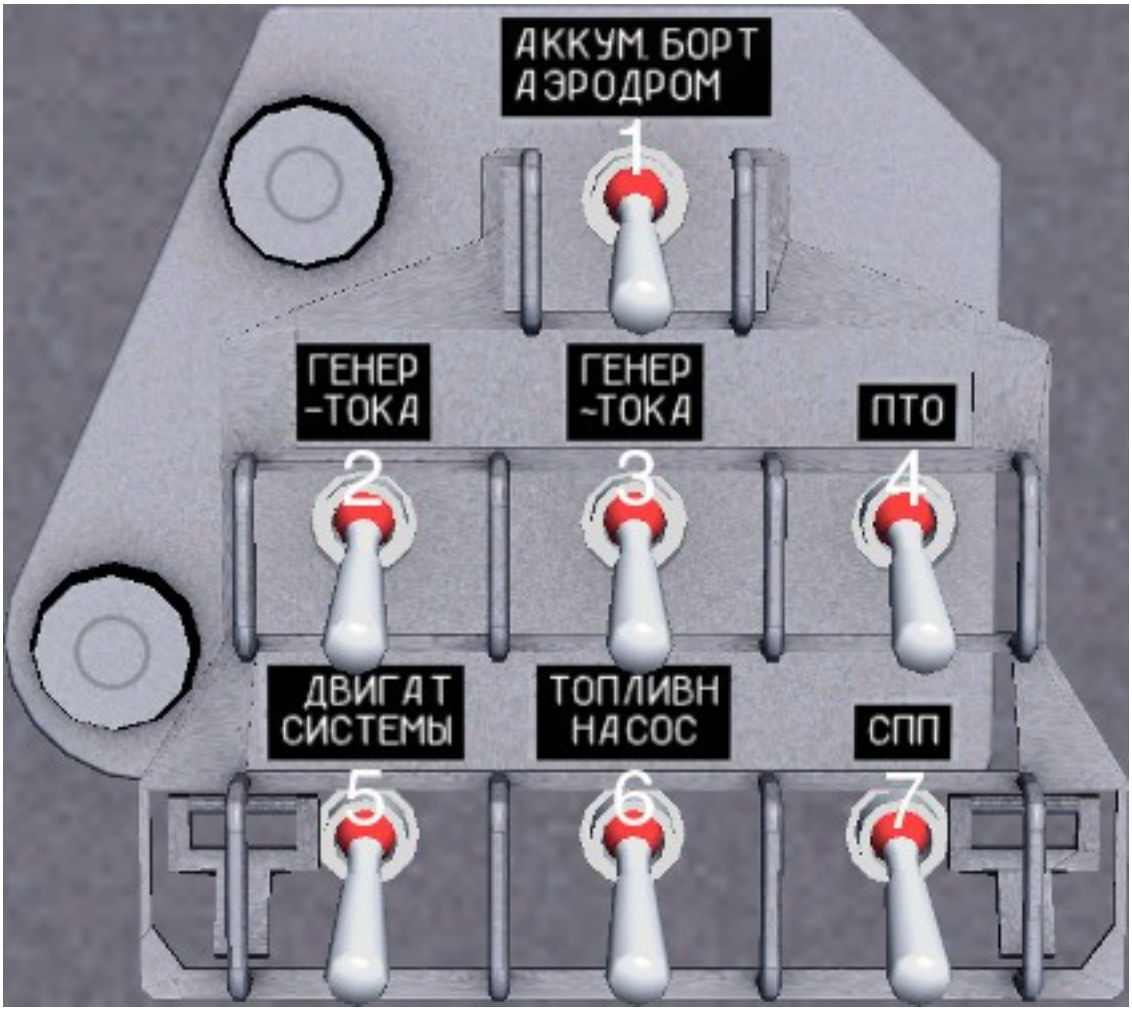
1. Knob of regulation of brightness of annunciators.
2. Button of check of lamps.
3. Switch of modes of navigation lights..
4. Knob of regulation of brightness of floodlight.

Aft lighting control panel



1. Knob of regulation of brightness of telelight panel..
2. Knob of regulation of brightness of lighting of control panels..
3. Knob of regulation of brightness of lighting of instruments.

Electrical power panel

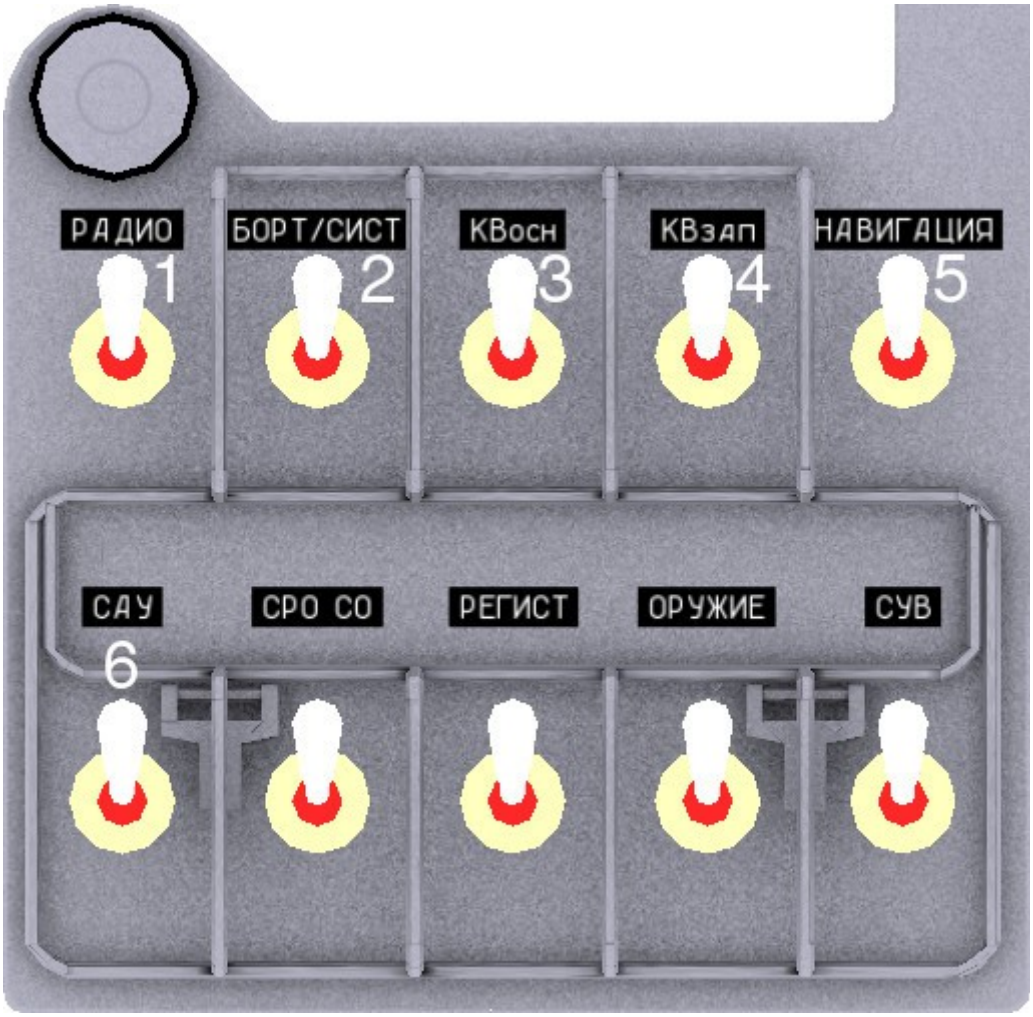


1. General power switch.
2. Switch of the DC generator.
3. Switch of the DC generator.
4. PTO switch (DC/AC comvertor).
5. Switch of engine systems.
6. Switch of the fuel pump.
7. Switch of SPP (Anti-Surge System).

Engine start panel

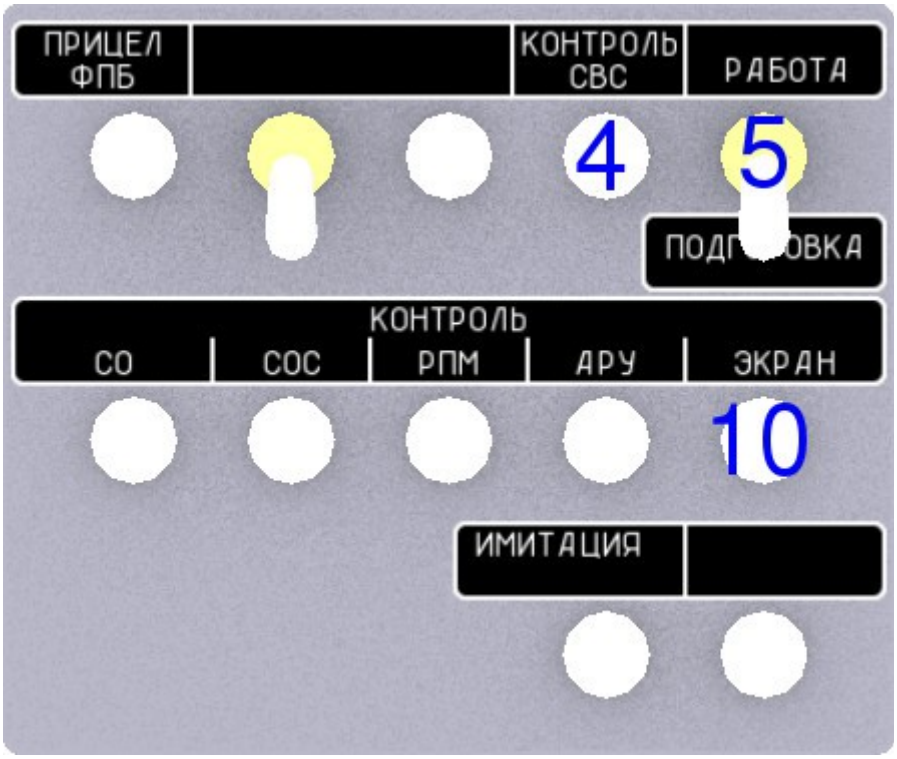
1. Switch APU MODE — START — ENGINE COLD CRANK — APU COLD CRANK.
2. Gnd start button.
3. Start-up mode switch.

System power panel



1. Radio power switch.
2. Aircraft systems power switch.
3. Main attitude and heading reference system power switch.
4. Reserve attitude and heading reference system power switch.
5. Navigation system power switch.
6. Aircraft flight control system power switch.

Control panel of the right board.



4. Button «КОНТРОЛЬ СВС».
5. Switch «РАБОТА-ПОДГОТОВ.».
10. Button «КОНТРОЛЬ ЭКРАН».

Informing on position throttle levers

When moving throttle levers position information is shown (display time 2 seconds) in the lower-left corner of the screen, inscription form: Throttle<n>: <namepos>.

Where n — number throttle lever (left - 1, right - 2), namepos — the position name in a short form.

.

Off	Stop
Idle	Idle
Military	Max
Minimal Afterburning	Min Afb
Full Afterburning	Full Afb

Procedure of start of engines

1. To close a canopy.

2. Connect the power supply ground. Item «External power On / Off» menu «MiG-29".

3. To turn on switches «АККУМ БОРТ АЭРОДРОМ», «ГЕНЕР - ТОКА», «ГЕНЕР ~ ТОКА», «ПТО», «ДВИГАТ СИСТЕМЫ», «ТОПЛИВН НАСОС» and «СПП» on a electrical power panel.

4. To turn on the switch «НАВИГАЦИЯ» on a system power panel.

4. To set the throttle lever of the started engine in position «Idle». For start of two engines, to set both throttle lever in position «Idle».

5. Set the start switch to the desired position. For start of the left engine — «ЛЕВ», the right engine — «ПРАВ», both engines — «ДВУХ».

6. To press the button «ЗАПУСК НА ЗЕМЛЕ».

7. After starting engines to disconnect ground power supply.

Preparation for take-off

1. To turn on the switches «БОРТ/СИСТ», «КВосн», «КВзап». If the air temperature is lower +5 ° and (or) the intended flight at high altitude, turn the switch «ОБОГРЕВ ПВД СТЕКЛА»

2. To check work system АРВ. For what:

- Make sure that the shutter position of the ИПК wedges aligned with the ВП, the display "Ekran" do not light warning signals and do not light КОНТРОЛЬ ВХОД ЛЕВ. and КОНТРОЛЬ ВХОД ПРАВ;
- to increase by 1-2 seconds RPM of engines to 80-90 %, lights КОНТРОЛЬ ВХОД ЛЕВ. and КОНТРОЛЬ ВХОД ПРАВ. thus should be highlighted;
- to reduce RPM of engines — a lights should go out.

3. To set a take-off course on PNP.

Take-off

1. To put on the brakes the aircraft..

2. Extend flaps.

3. To set the throttle levers in position «Max».

4. After exiting the engines at maximum thrust, brake release and start to run..

5. Airplane lift-off for speeds of 240-250 km/h, an angle of tangage 10-11°.

6. At height of 10-15 meters to retract gear.

7. At height of 100 meters to retract flaps..

Landing

1. At speed of 440 km/h raise gear.

2. At speed of 400 km/h extend flaps.

3. Landing to make for speed of 250-270 km/h.

4. After touchdown the main landing gear wheels, smoothly lower the nose of the plane, and if necessary to deploy the brake parachute..

5. At speed of 215 km/h begin to put on the brakes aircraft.

Engines shutdown

For a stop of the engine (engines) to set throttle lever(s) of the stopped engine(s) in the position «Off».

Control of AFCS

Control of AFCS is made from the control panel (PU-189) and using the controls located in the stick. On the control panel buttons are lamps: ДЕМП., УВОД, СТАБ. ВЫС., АП, ТР. УПР., ПОВТ. ЗАХОД, serving for the inclusion of appropriate modes of AFCS.
On the stick, trim button, ВЫКЛЮЧ. РЕЖИМА САУ (AFCS MODE OFF) button, ПРИВЕД. К ГОРИЗ. button, AP cut-out lever.

The AFCS is capable of performing the following modes of operation:

- «Damper»
- «Attitude hold»
- «Altitude hold»
- «Auto recover» (level off mode)
- «Levelling» (automatic unusual attitude recovery)
- automatic landing approarch control. *The mode of automatic control at landing approach isn't debugged.*

«Attitude hold»

To engage the attitude hold mode, the АП button on the autopilot control panel is pressed. At bank angles from 7° to 80° and pitch angles of ±80°, the aircraft attitude is maintained. At bank angles below 7° an pitch angles of ±40°, attitude and heading are maintained.

«Altitude hold»

Altitude hold is engaged by pressing the АП button first and then the СТАБ. ВЫС. button on the autopilot control panel.

«Auto recover»

Auto recover mode is designed to recover the aircraft to a minimum altitude set on the radar altimeter during flights below 1500 meters above ground level.

It is engaged by pressing the УВОД button on the autopilot control panel. However, engagement should not take place when flying below the preset minimum altitude.

«Levelling»

Levelling mode is designed to recover the aircraft to straight and level flight in case of pilot's spatial disorientation. Pressing the ПРИВЕД. К ГОРИЗ. button on stick.

Director and automatic control at landing approach

The mode of director control activate ТР. УПР. button-lamp pressing. The mode of automatic control activate consecutive pressing of the ТР. УПР. and АП button-lamps.

Navigation system

General information

The system of navigation is intended for continuous automatic determination and delivery to consumers of the flight and navigation parameters necessary for control of airplane at conducting combat operations, flight on a route, an entry into airfield of landing, performance of prelanding maneuver and landing approach.

Navigation preparation

Navigation preparation includes:

Determination of coordinates of the center and landing runway heading of home airfield and spare airfields, coordinates of waypoints and radio beacons.

Input of certain coordinates, landing courses, ILS channels. Input is made with use of dialogue of the panel of input of programs (PIP), the item «PVP» of the «MiG-29» menu.

Note: Navigation preparation is made before start of engines.

Dialogue panel of input of programs

The input fields are divided into three groups:

- Aerodromes: Entry fields of coordinates, course, numbers of ILS channels of airfields. Coordinates are entered in the x.y format, where x — degrees, and y — shares of degrees. Number of figures after a point the any.
  The course is entered in a format 0 — 179,99.
  Numbers of ILS channels are entered in a format 01-40. In the first field you enter the channel number ILS runway 0-179,99 course, in the second field, enter the channel number

with the course ILS runway 180-359,99. To determine the frequency of the ILS, use the table Appendix B.

- Waypoints: Entry fields of coordinates of waypoints.
  Coordinates are entered in the x.y format, where x — degrees, and y — shares of degrees.
  Number of figures after a point the any.
- Beacon – RSBN: Entry fields of coordinates and channels of radio beacons.
  Coordinates are entered in the x.y format, where x — degrees, and y — shares of degrees.
  Number of figures after a point the any.

Express (basic) preparation

The mode of the accelerated preparation can be begun as before start of engines (at connected ground power supply), and after start of one or both engines and a detachment of ground power supply.

Mode starts after the power switch КВосн, КВзап, НАВИГАЦИЯ and setting the switch РАБОТА-ПОДГОТОВ. on the right panel in the position ПОДГОТОВ. (Put before power).

Further process depends on position of the switch РАБОТА-ПОДГОТОВ.

When the switch is in the position РАБОТА (not more than 1.5 minutes after switching on) IK-VK automatically switches to run mode, after 2-3 minutes after the engaging navigation system lights display УСКОР. ГОТОВ.

If the switch is not set to "РАБОТА" during this time, starts basic preparation mode. In this case the switch has to is in position ПОДГОТОВ. before light of a board of НАВИГ. ГОТОВ., which testifies to readiness of naviation system for work in a mode of inertial dead reckoning.
Accuracy inertial dead reckoning mode - 8 km per hour of flight.

Control the navigation system

Mode «Navigation»

The mode is used when flying on the set route or for an exit to the programmed waypoint. The type of a navigation point gets out the ППМ-АЭР switch. At approach to the next waypoint, it is necessary to press the button lamp of the following waypoint.

Mode «Return»

Mode is activated by pressing the ВОЗВРАТ button-lamp and the appropriate airport landing АЭР. At mode engaging the trajectory of return is formed on the first airfield irrespective of position of the ППМ-АЭР switch, and button number of a number of ППМ-АЭР". For return after ВОЗВРАТ button lamp pressing — to press the button lamp of the necessary airfield other programmed airfield.

Mode «Landing»

In the "Landing" navigation system switches automatically when finding the plane at a distance from the center of the runway from 8 to 37.5 km and a lateral deviation from the runway from 1 to 4 km, respectively, for the difference between the current and landing course less than 60 ° and altitude less 1400 meters. Engaging of a mode can be made and manually the switch ПОСАДКА when in range of the localizer.

Appendix A: MiG-29 keyboard shortcuts

1. Shift-C — Open/close a canopy.
2. K — Extend speed brakes.
3. Chift-K — Retract speed brakes.
4. J — Deploy drag chute.
5. Chift-J — Jettison drag chute.
6, O — AP cut-out lever.

Appendix B: Table of ILS channels

Channel	Frequency	Channel	Frequency
01	108,1	21	110,1
02	108,15	22	110,15
03	108,3	23	110,3
04	108,35	24	110,35
05	108,5	25	110,5
06	108,55	26	110,55
07	108,7	27	110,7
08	108,75	28	110,75
09	108,9	29	110,9
10	108,95	30	110,95
11	109,1	31	111,1
12	109,15	32	111,15
13	109,3	33	111,3
14	109,35	34	111,35
15	109,5	35	111,5
16	109,55	36	111,55
17	109,7	37	111,7
18	109,75	38	111,75
19	109,9	39	111,9
20	109,95	40	111,95