NCNS
Manual

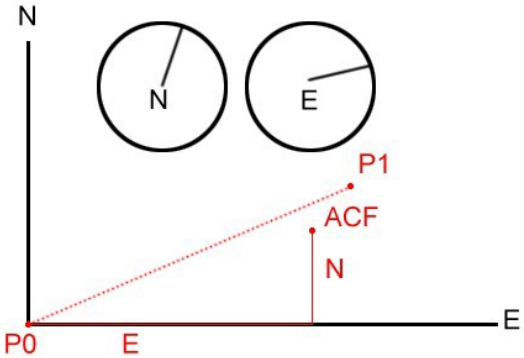
The non-cooperative navigation system NCNS (Навигационная автономная система НАС-1) is a Russian dead reckoning navigation system. Therefore it allows navigation completely independent from radio stations.

*This system uses heading from the gyro direction indicator (GDI), ground speed and drift angle to calculate the flightpath of the aircraft. Ground speed and drift angle may either be provided by the automatic navigation unit **ANU**, which requires manually input or automatically by the Doppler ground and velocity system - Doppler navigator (**DNAV**) (доплеровский измеритель скорости и сноса ДИСС).*

Several instruments display the distance of the aircraft relative to a starting point in an adjustable map system.

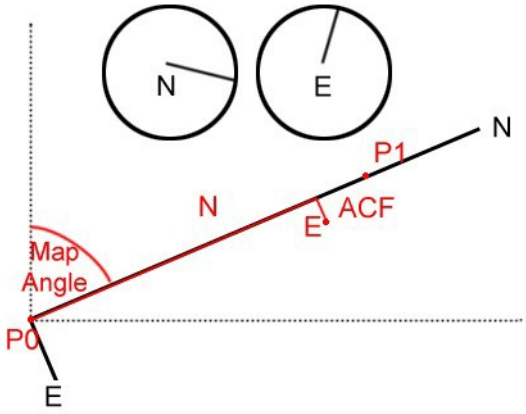
Map angle:

This needle can be used to rotate the angle of the map system.
Take a look at the scheme below:



The map angle is in this case 0°. We want to fly from point P0 to point P1. After some time, we find the aircraft at the marked position. The two gauges indicate how far the aircraft has flown North and East from point P0.

If we use the same situation, but rotate the map to the route course, we'll these indications:



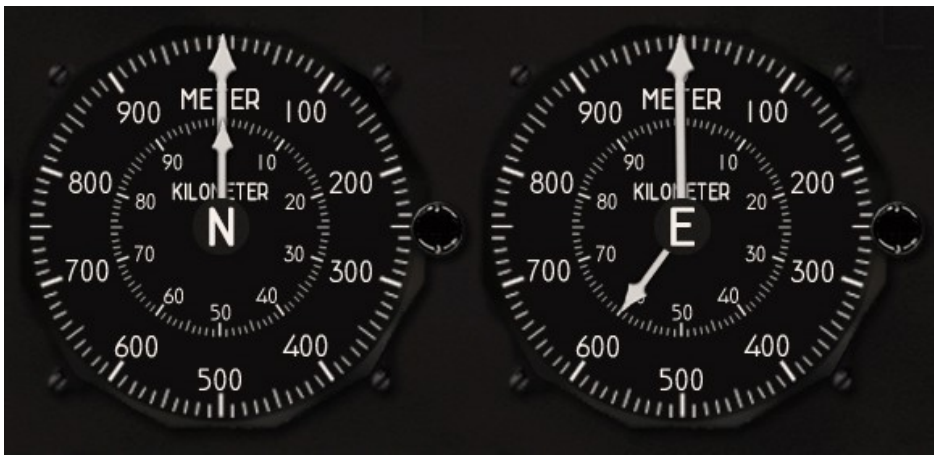
The gauge previously pointing North will now show us the distance from P0 on the route. The East gauge will show us our deviation from our course in this case.

When passing a waypoint on the route, the map angle will usually be changed to the new course. The change of the gauges must be done quickly, or some bias will arise. To help you with changing, presets can be set with the top screws of the map angle gauge. Clicking the upper left screw will decrease the preset map angle, clicking the upper right screw will increase the map angle.

The selected preset map angle will be shown above the map angle instrument (for preset values other than 360°). Clicking the preset indication at the top will reset the preset value back to 360°.

Clicking in the middle of the map angle gauge will adjust the map angle to the preset value.

Counters



These two gauges are the counters, as previously depicted in the map angle schematics. The left one shows the deviation to the North on the reference map and the right one shows the deviation to the East on the reference map. One full rotation of the big needles are 1000 meters and one rotation of the small needles are 100 kilometers.

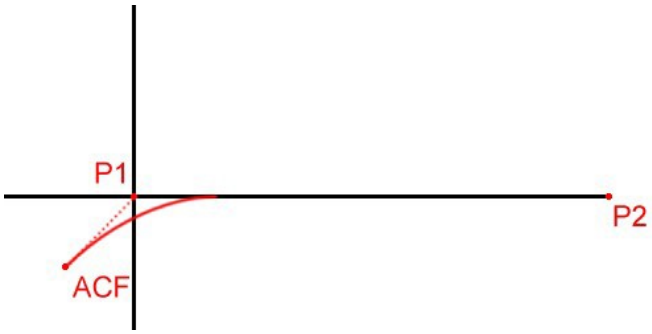
Right of each gauge is a knob to modify the deviation indications. This can be used to reset the indications after passing a waypoint, or to correct any bias.

You can use presets for the counters just like the map angle. Simply use the upper screws to set the preset angle and click in the middle of the gauges to apply the presets. Clicking on the preset indication at the top will reset the preset value to 0 and blank it out.

This instrument works like the other two counters, but one full rotation is 1000km.
The little window at the top of the instrument depicts the deviation to the North up to 5000km.

Presets

Why are the presets so important?
When you switch to the next waypoint, you want the center of your map coordinates to be at the previous waypoint (P1), so that the North counter will precisely show the distance to your next waypoint (P2). Unfortunately, you usually don't exactly overfly your waypoint, but you turn in advance, as illustrated below:



This means, there is no point were you could set the counters to 0. Therefore, preset values need to be calculated.

*The An-24 comes with a simulated smartphone, which includes an app to calculate the preset values. With **Course 1**, you enter your course before turning and with **Course 2**, you enter the desired course after your turn. Set your desired **Bank** angle and **TAS** and you can read out the calculated values. Start turn indicates how early you should start your turn. In the example at the right, you should start your turn 2108 meters before reaching P1.*

When starting your turn, set the NCNS gauges to last to two values.

Counter switches

The counters will do nothing if they are not engaged ;-)

This selects the source for the counters.

DNAV *mode uses data from the Doppler radar. The radar will automatically calculate the ground speed and the drift angle.*

The lower position selects the automatic navigation unit ***ANU*** *(автоматического навигационного устройства АНУ) as the source.*

The ***ANU*** *needs wind input from this gauge to work correctly:*

MA (Map Angle) is an indication of the selected map angle. The map angle must be set before setting the wind angle.

δ is used to enter the wind direction. Use the right knob to set it.

In the middle part, the wind speed is set in KM/H.

The ***ANU*** *uses this information, together with the TAS and heading from the GDI to calculate the GS and the drift angle.*

The wind information should be updated every 15 minutes to improve accuracy.

Doppler navigator Console

This console is used to control the Doppler navigator.

The Doppler navigator is unpowered when the left switch is ***OFF****.*

When the switch is moved to ***ON****, the Doppler navigator is powered with a low voltage. The green lamps will also lit up.*

MEM *is used to manually switch to memory mode, more about this later.*

HIGH VOLT *includes a high voltage, the Doppler navigator will now receive the GS and drift angle from the radar.*

The red lamp will indicate that the ***HIGH VOLT*** *mode is active.*

The radar image differs on land and sea. Therefore the ground speed can vary on different grounds (up to 2.5%). To correct the errors, the right switch must be set to ***LAND*** *or* ***SEA****, whether the aircraft flies over land or water. Please keep in mind that the speed indication may still show some errors over the water, because the radar reflections are not optimal over water. It might also occur that no valid radar data can be obtained if the waves on the ocean are too small.*

All these effects are actually realistically simulated in this NCNS simulation, so don't forget to set this switch! ;-)

COUNT 1 *and* ***COUNT 2*** *are used for testing and only operated during preflight.*

Memory Mode

Whenever the radar signals are invalid, the Doppler navigator will switch into memory mode.

There could be several reasons for the radar signal to be invalid:

-If the pitch or bank angle of the aircraft is greater than 10°, the radar signals will be invalid due to large tilt

-When flying over water with very small waves, the radar signals are not reflected

-The radar is switched off

When the Doppler navigator switches to memory mode, it will store the last ground speed and drift angle to continue dead reckoning. Only when the radar data is valid again, these values will be updated.

If the Doppler navigator is operating in memory mode, this pattern will appear in the window of the drift angle gauge:

As the drift angle is from the moment the radar signals became invalid and do not update, it is not recommend to stay in memory mode when turns are made. In this case, or if flying in memory mode for a long time, switch the ***DNAV-ANU*** *switch to* ***ANU*** *and enter the wind manually.*

Drift angle and speed

This gauge shows raw information about the drift angle and the ground speed, as used by the counters.

Navigation

There are many ways to navigate using the NCNS. I'll describe the easiest way.

Prior to takeoff, move the map angle to your planned course.

Make sure the ***DNAV-ANU*** *switch is set to* ***DNAV****.*

Turn the Doppler navigator on and make sure the green light is lit. Set the right switch to ***LAND*** *or* ***SEA****. Also turn the radar (overhead panel!).*

Shortly after takeoff, switch the Doppler navigator to ***HIGH VOLT*** *and the counters to* ***ON****. The North counter will show your distance from departure on your course, the East counter is used to correct you lateral deviation and should always point to 0.*

Before reaching the first waypoint, calculate the preset values and enter them as presets.

When you reach the distance where you should start your turn, use the preset switches to set the map angle and the counter presets. Don't forget to tell the autopilot to turn, too!

You'll now be flying to your second waypoint.

The NCNS system will collect bias the longer you fly. Therefore it is highly recommend to use radio stations to correct the NCNS data. Use the knobs beside the gauges to change the values according to the data from radio station.

It should also be noted that the heading information comes from the GDI, therefore it must always be correctly aligned!

For further information on how to navigate with the NCNS, I highly recommend this guide by Gabor Hrasko :
http://samdimdesign.free.fr/HTML/An24/docs24/An-24RV_v2.htm#_Toc105077699