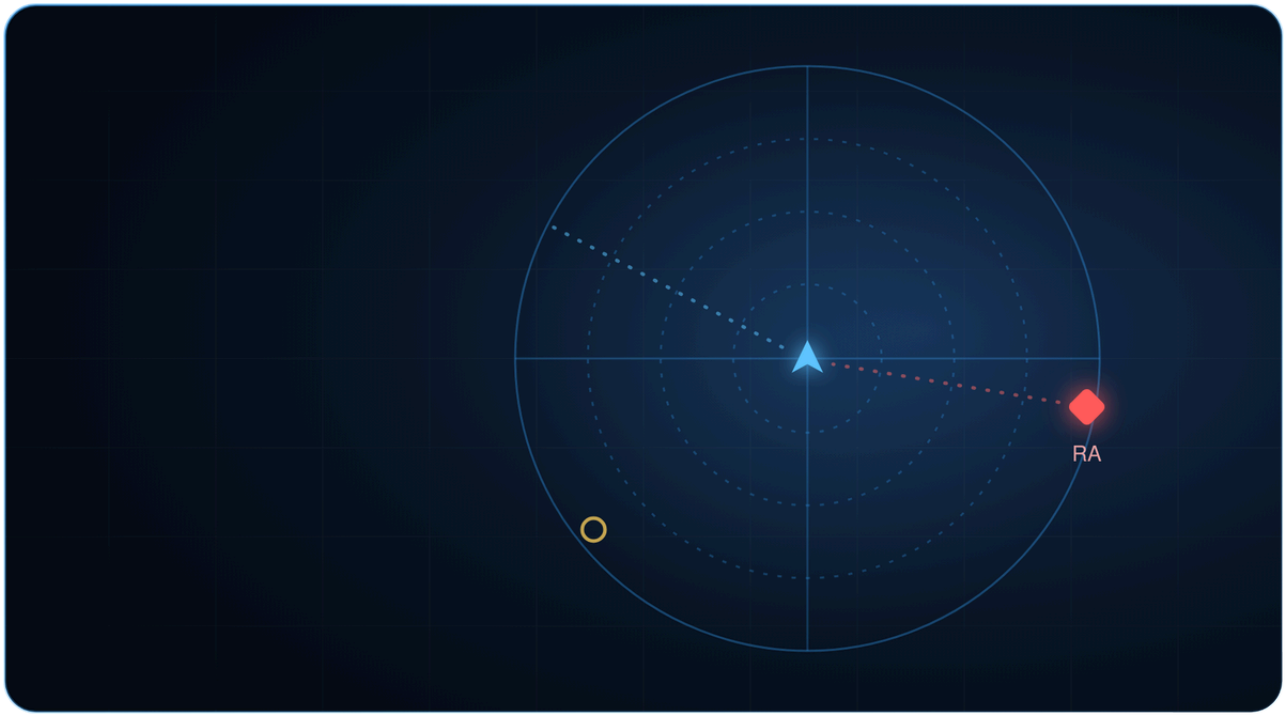
TCAS Trainer



Deterministic TCAS Encounter Training for X-Plane 12

User Guide — Version 1.0.1

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Contact: support@midwestsimulations.com

Introduction

What is TCAS Trainer?

TCAS Trainer generates precisely-configured, repeatable TCAS (Traffic Collision Avoidance System) encounters in X-Plane 12, so you can rehearse the procedure for responding to a Traffic Advisory or Resolution Advisory — on demand, exactly the way you want it, as many times as you like.

Two things worth being clear about up front:

- **TCAS Trainer is not a TCAS unit.** It doesn't replace, emulate, or certify to any real TCAS/ACAS hardware or software standard. Its Resolution Advisory logic is a simplified training model built for realistic *procedure* practice, not a certified collision-avoidance implementation.
- **TCAS Trainer is not a live traffic generator.** Unlike tools that reflect real-world air traffic (such as LiveTraffic), it has no connection to actual flights anywhere. Every intruder is entirely synthetic — an aircraft you configure yourself, placed at an exact range and bearing, passing at an exact offset and altitude, spawned only when and where you ask for it.

What it *is*: a way to script an exact TCAS encounter and fly it as many times as you need — the same way every time, or deliberately varied to practice different geometries, closure rates, and Resolution Advisory senses.

Why practice this?

Most pilots — real-world or simulated — go a long time between genuine TCAS Resolution Advisories. That scarcity is exactly the problem: an RA demands an immediate, correct, and specific response (follow the RA's commanded rate promptly, even if it conflicts with an ATC instruction; don't reverse the maneuver; monitor for "Clear of conflict"), and procedures that are rarely exercised are the ones most likely to be fumbled under the mild stress of an actual encounter. TCAS Trainer exists to close that gap: because encounters are cheap, safe, and repeatable here, you can build and maintain the same procedural reflexes a real event would demand, at your own pace.

TCAS Trainer does not fly your aircraft

TCAS Trainer has no access to, and never touches, any system of the aircraft you are actually flying in X-Plane — not the autopilot, not the flight controls, not the autothrottle, nothing. It only creates and positions *separate* intruder aircraft nearby and feeds their data into X-Plane's own native TCAS system, exactly as a real transponder-equipped aircraft's position would be. Responding to the resulting Traffic Advisory or Resolution Advisory — disconnecting the autopilot if needed, hand-flying the commanded climb or descent, recovering afterward — is entirely up to you. That's the point: since TCAS Trainer cannot fly the response for you, practicing with it exercises exactly the skills a real encounter would demand.

TCAS Trainer also has no control over *how* your specific aircraft decides to raise an alert. Detecting traffic and deciding when to call a Traffic Advisory or Resolution Advisory is done by your aircraft's own TCAS implementation — built into the aircraft add-on itself, or X-Plane's generic default if the add-on doesn't model one — using whatever thresholds and timing that implementation chooses. What TCAS Trainer *does* control is the other side of the encounter: it computes its own Resolution Advisory for the synthetic intruder it generates (that's the sense shown in the intruder's own Status row — see Reading the Status). Your aircraft's real TCAS reaches its own, independent decision from that same underlying geometry, and can do so at a slightly different moment — or even reach a different conclusion — than TCAS Trainer's own simplified model shows for the intruder. That's expected: the two are separate systems looking at the same encounter from opposite sides, not one mirroring the other.

Three terms come up throughout this guide:

- **Traffic Advisory (TA)** — an alert that another aircraft is close enough to watch, without yet requiring a maneuver. Typically an aural "Traffic, Traffic" call and an amber traffic symbol on the ND.
- **Resolution Advisory (RA)** — an alert that demands an immediate vertical maneuver to maintain safe separation. Typically an aural command ("Climb, Climb" or "Descend, Descend"), a red traffic symbol, and vertical-speed guidance on the PFD.
- **Clear of Conflict** — the call announcing that an RA is no longer needed: safe separation has been reestablished, and you can return to your previous clearance.

Key Features

- **Up to 8 independent intruders**, each with its own aircraft type, livery, and encounter geometry
- **Precise encounter geometry** — set exactly where an intruder starts, and exactly where and how close it passes you, independently of aircraft speed
- **Genuine TCAS integration** — TCAS Trainer writes directly into X-Plane's own TCAS target arrays, so Resolution Advisories appear on your real TCAS/ND display and trigger your aircraft's own aural alerts, not just a status readout inside the plugin
- **Optional intruder RA reaction** — let an intruder climb or descend in response to its own Resolution Advisory, or hold its course
- **Configurable Resolution Advisory strength** (climb/descend rate) for that intruder reaction above — this governs how the *generated traffic* reacts, not your own aircraft's response, which is entirely up to you and your own aircraft's systems — plus automatic re-arming after each encounter
- **Collision-proximity warnings** while you configure an encounter, so you can see at a glance if a configured geometry is dangerously close
- **Intercept fighter** — an independently-configured aircraft that flies up and holds station on your wing
- **Commands and datarefs for every control**, so encounters can be triggered from another plugin, a hardware panel, or a scripted scenario — see the Dataref and Command Reference
- **Per-machine licensing** with clear, granular feature gating (see Licensing below)

Licensing

TCAS Trainer is licensed per machine. You receive a license code with your purchase and exchange it for a signed license file that is tied to your computer (see Installing Your License). The file grants one or more named features:

License feature	What it unlocks
`INTRUDER`	A single intruder slot (slot 1 only)
`INTRUDERS`	All 8 intruder slots
`INTERCEPT`	The intercept fighter
`SANTA`	The Santa Claus aircraft (CSL type `SSLH`) in the aircraft-type lists
`PROFESSIONAL`	Marks the license as authorized for professional use. No function depends on it; the General page shows whether your license covers professional use or home/hobby use only

Any feature not granted by your license is fully disabled — it cannot be activated from the configuration window, nor from a command or dataref. The General page always shows exactly which features your current license enables (see The General Page).

When do you need the PROFESSIONAL license?

TCAS Trainer follows the rule that Laminar Research sets for X-Plane itself. Laminar Research explains at www.x-plane.com/pro (https://www.x-plane.com/pro) what makes it "X-Plane for professional use". Condition 2 reads:

> It licenses your simulator for commercial use (that is, any use of X-Plane outside of your own personal use in your own personal home.) This license is also required for generating revenue, either directly or indirectly, using X-Plane.

In practice: **if your use of X-Plane requires an X-Plane for professional use license under that condition, TCAS Trainer requires the PROFESSIONAL license as well.** This applies, for example, to training organizations, flight schools, businesses, and anyone who uses X-Plane and TCAS Trainer outside their own personal home or to earn revenue, directly or indirectly. If you use TCAS Trainer only for yourself, at home, as a hobby, a license for home/hobby use is enough.

A PROFESSIONAL license has exactly the same features as an ADVANCED license; only the license terms differ. The General page tells you which kind you hold (see Installing Your License). If you are unsure which one you need, check Laminar Research's current terms at the address above, or contact **support@midwestsimulations.com** before you buy.

CSL Aircraft Models

Every aircraft TCAS Trainer renders — intruders and the intercept fighter alike — is drawn using an installed CSL model package, the same shared format used across the X-Plane multiplayer and traffic ecosystem. TCAS Trainer does **not** ship CSL models itself — the one exception is the **Christmas edition**, which comes with a single CSL model, Santa Claus; see The Christmas Edition. See Installing CSL Aircraft Models for what CSL models are and where to get them. Without at least one CSL model installed, TCAS Trainer has no aircraft to draw and disables every feature until one becomes available.

Contact, Suggestions, and Bug Reports

TCAS Trainer is community-driven. Midwest Simulations actively wants to hear from you — bug reports, rough edges, and especially ideas for what you'd like to see next. Frequently-requested features are prioritized for future releases, so if there's something missing, say so.

Midwest Simulations Support, suggestions, and bug reports: **support@midwestsimulations.com**

Installation and Initial Configuration

Requirements

- X-Plane 12
- Windows, macOS (Intel or Apple Silicon), or Linux
- A CSL aircraft model package (see below) — without one, TCAS Trainer has nothing to render. (The **Christmas edition** comes with a single CSL model, Santa Claus, so it has an aircraft to draw right away — but only that one.)
- A valid TCAS Trainer license (see Licensing) — without one, TCAS Trainer runs but every feature is disabled
- If your setup uses one or more separate computers purely as external visuals, the **XPMP2 Remote Client** (plus its own copy of the CSL models) installed on each of them — see External Visual Computers

Installing the Plugin

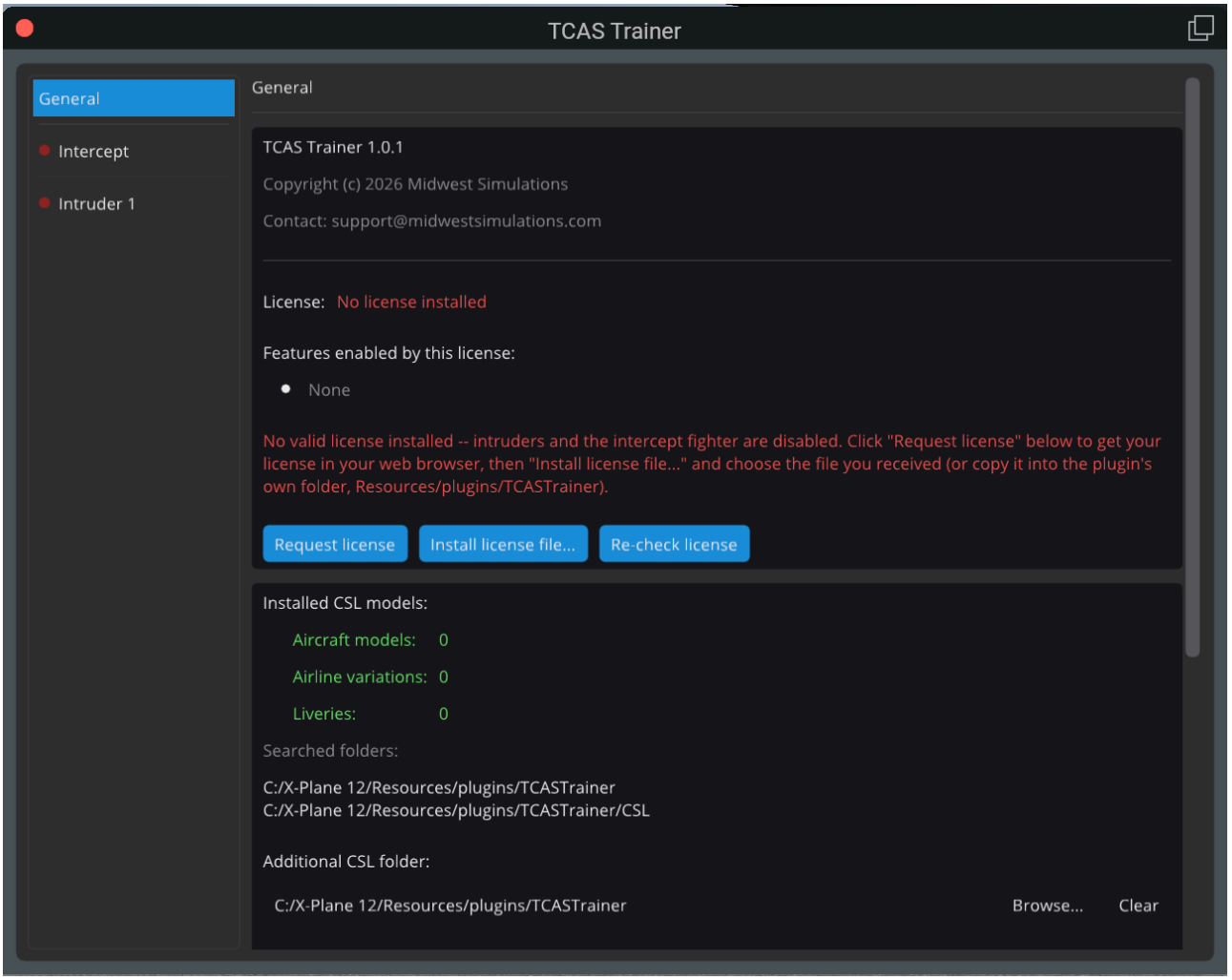
Download the latest version from https://www.midwestsimulations.com/tcastrainer/downloads (https://www.midwestsimulations.com/tcastrainer/downloads) (earlier versions are listed there too), and unzip the downloaded package directly into your X-Plane installation's `Resources/plugins/` folder. The result should look like this:

```
X-Plane 12/
  Resources/
    plugins/
      TCASTrainer/
        win_x64/TCASTrainer.xpl      (Windows)
        mac_x64/TCASTrainer.xpl      (macOS, universal Intel + Apple Silicon)
        lin_x64/TCASTrainer.xpl      (Linux)
        fonts/...
        Resources/...
        CSL/SSLH/...        (Christmas edition only: the Santa Claus model)
```

Start (or restart) X-Plane. TCAS Trainer appears as a new **TCAS Trainer** entry in the **Plugins** menu, with a **Show/Hide Configuration** item that opens its configuration window.

First Run

The first time TCAS Trainer runs on a machine, it hasn't been licensed yet and has no CSL aircraft models to draw with — it automatically opens its configuration window on the **General** page to make both plain:



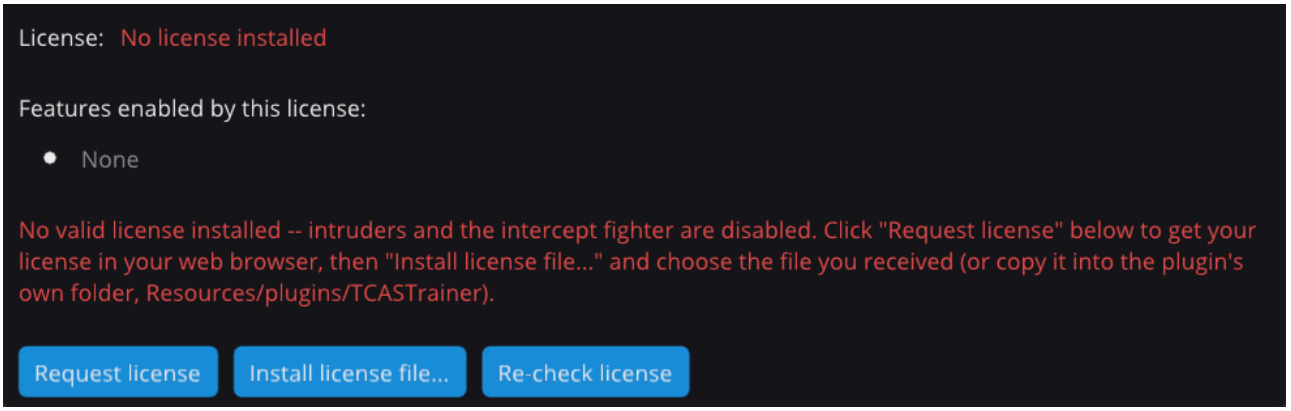
You can also open this window yourself at any time via **Plugins → TCAS Trainer → Show Configuration**, or via the `xtcas/configuration/toggle` command (bindable to a joystick button or keyboard shortcut in X-Plane's own settings). The rest of this section walks through clearing both problems shown above.

Installing Your License

TCAS Trainer is licensed per computer. When you buy it, you receive a **license code** — 25 letters and digits in five groups of five (`XXXXX-XXXXX-XXXXX-XXXXX-XXXXX`). You exchange that code, on the license page of Midwest Simulations, for a **license file** named `TCASTrainer.lic` that is tied to your computer, and install the file in TCAS Trainer. The whole procedure takes about a minute; you need a web browser on the same computer, and no restart of X-Plane.

A license code can be used on **up to three of your computers**. Repeat the procedure on each one; every computer gets its own license file.

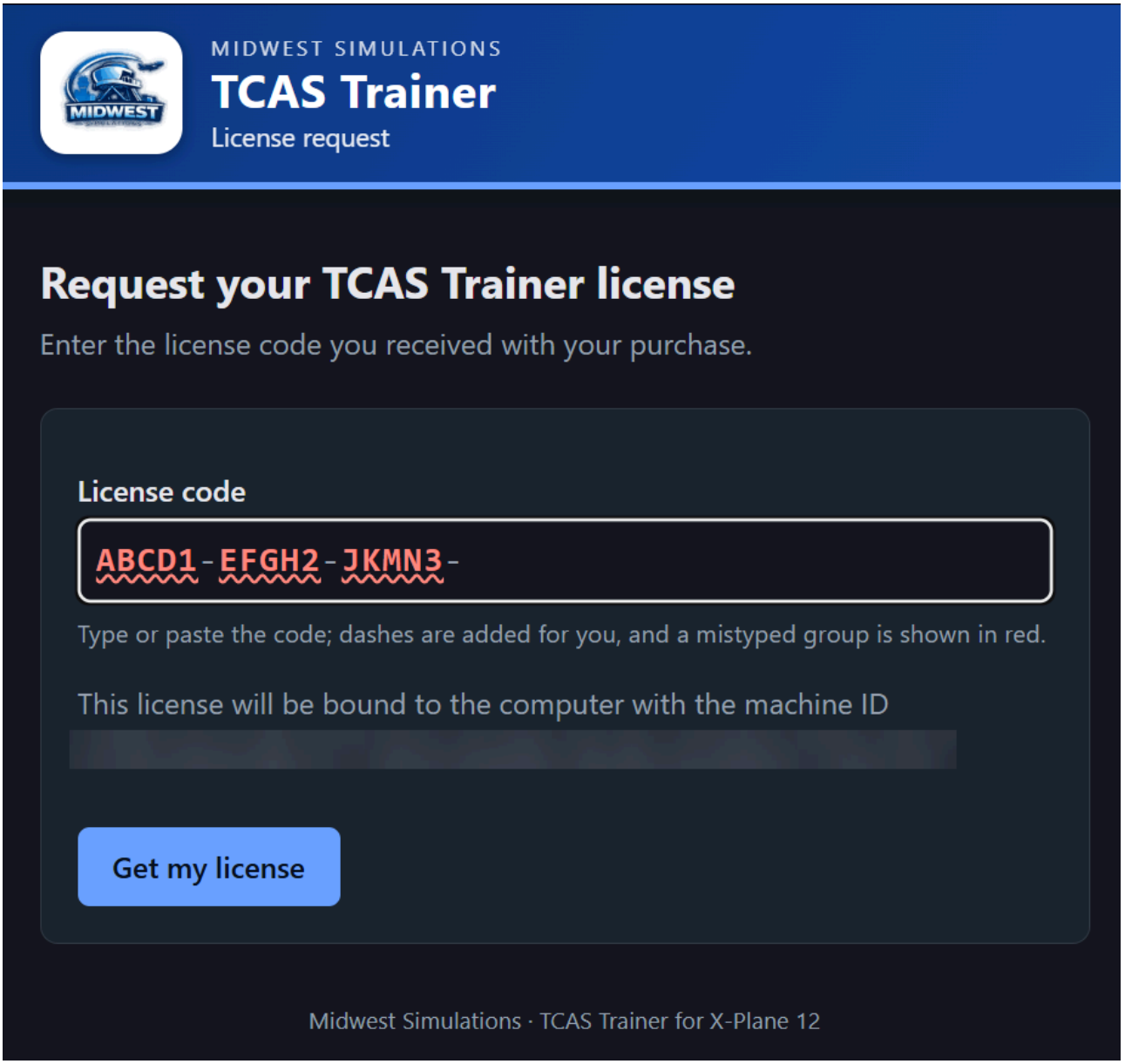
Step 1 — Request your license. Open **Plugins → TCAS Trainer → Show Configuration** if the window is not open already. Without a license, the License line of the General page reads *No license installed*. Click **Request license**, the first of the three blue buttons. A message below the buttons confirms the click while the browser starts, which can take a few seconds:



Your web browser opens the license page of Midwest Simulations. Your computer is identified automatically through the address of that page, so there is nothing to look up or copy: the machine ID shown on the page is only for your information.

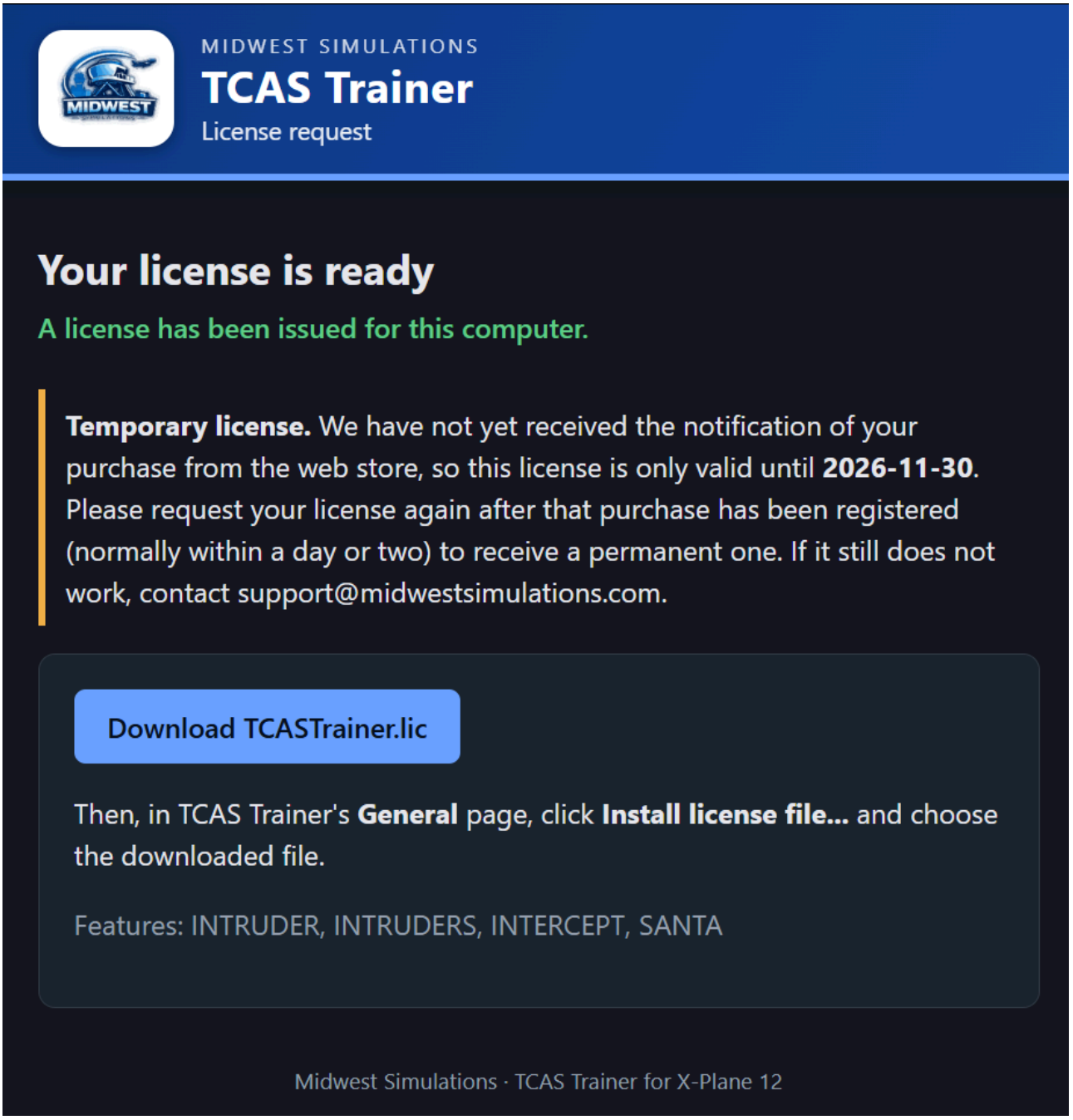
Step 2 — Enter your license code. Type the code you received, or paste it. The page checks it while you type:

- Letters are converted to upper case, and anything that cannot be part of a code (spaces, punctuation, the letter U) is ignored. Codes never contain the letters O, I and L; if you type them, they are read as the look-alike digits 0, 1 and 1.
- The dashes between the groups are added for you. You do not need to type them, and typing a dash does nothing.
- Every group of five ends in a check character. A group that is typed wrongly turns **red** as soon as it is complete, so you can see where the typo is. Until all five groups are correct, the page does not let you continue.



When all five groups are correct, click **Get my license**.

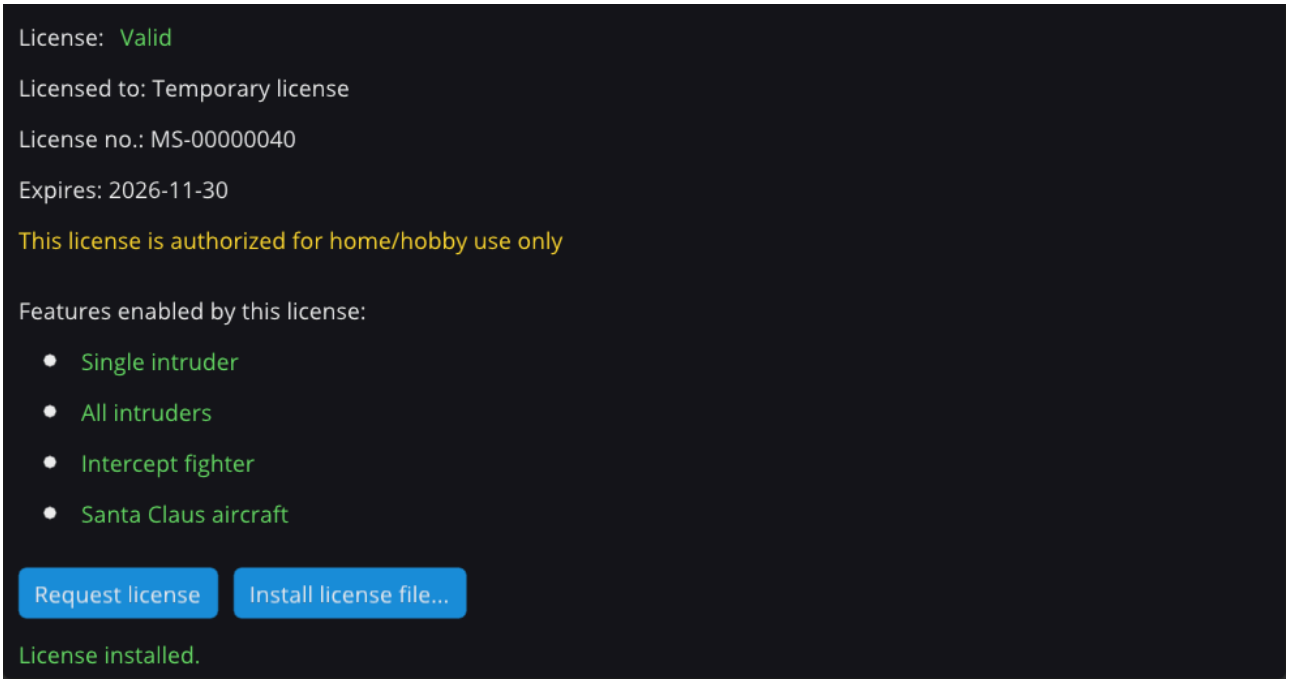
Step 3 — Download the license file. The page confirms *A license has been issued for this computer*, lists the features the license enables, and offers the file for download. Click **Download TCASTrainer.lic**; your browser saves it, normally in your *Downloads* folder.



If a note on the page says **Temporary license**, Midwest Simulations has not yet received the notification of your purchase from the web store. The license then works for a limited time only (two weeks), and the page shows the date it expires. This can happen right after a purchase; the purchase is usually registered within an hour or so. Request your license again then, in exactly the same way, to receive the permanent one, and install it as described below. Installing a new license file replaces the previous one.

Step 4 — Install the license file. Back in X-Plane, click **Install license file...** and choose the file you just downloaded. The file chooser normally opens in your *Downloads* folder and lists only `.lic` files. If you have downloaded licenses before, your browser may have named the new one `TCASTrainer (1).lic` or similar — choose the most recent one.

TCAS Trainer checks that the file is a valid license for *this* computer and, only if it is, copies it into place — as `TCASTrainer.lic` in TCAS Trainer's own plugin folder, `Resources/plugins/TCASTrainer` — and switches it on at once. The General page now shows **License installed.**, and the intruders and the intercept fighter become available:



The License section tells you:

- **License:** *Valid*.
- **Licensed to**, **E-mail** and **License no.** — who the license was issued to (a temporary license is issued to *Temporary license* instead of a name). The license number is worth quoting if you contact support.
- **Expires** — the date a temporary license ends, or *never* for a permanent license.
- **Whether the license covers professional use.** A license for **home/hobby use only** is marked in yellow — *This license is authorized for home/hobby use only* — and a license for **professional use** in green — *License authorized for professional use*. (This is a statement of what your license allows; it does not switch any function on or off.)
- **Features enabled by this license** — exactly the features you can use (see Licensing). Any other feature stays disabled.

The **Re-check license** button, which is only needed while no valid license is installed, disappears once the license is valid.

Good to know

- A file that cannot be used is **never installed** and never replaces a working license: TCAS Trainer shows *Not installed* in red and says why — for example *wrong machine* (the file was issued for another computer; request the license again on this one, using this computer's **Request license** button), *expired*, *not signed* or *bad signature* (the file is damaged or not a license), or that it could not be read as a license at all.
- TCAS Trainer re-checks the installed license by itself every two minutes. If you would rather install the file by hand, copy it into `Resources/plugins/TCASTrainer`, name it `TCASTrainer.lic`, and click **Re-check license**.
- If the license page says that the code is not valid, check it for typos (the red groups of Step 2 normally catch them). After several wrong codes in a row from the same network, the page asks you to wait a while before it accepts another try.
- If the page says that the code has already been used for the maximum number of computers (three), or that it is no longer valid, or if the computer has no web browser, or if you have a new computer and ran out of activations, contact **support@midwestsimulations.com** and quote your license code.
- Keep your license code in a safe place: it is what activates a license on a new computer. Do not share it.

Installing CSL Aircraft Models

What is a CSL model? CSL ("Custom Scenery Library") is a shared, standardized 3D-aircraft-model format used across the X-Plane multiplayer and traffic ecosystem — the same format IVAO, VATSIM, LiveTraffic, and TCAS Trainer itself all draw from. Rather than every plugin bundling its own copy of every airliner and livery, CSL packages are installed once, in one folder, and shared by whichever plugins need to render traffic.

A CSL model is not the same kind of aircraft model you actually fly. It exists purely to be *seen* from outside — a 3D shape, a livery, and a handful of animated surfaces (gear, lights, control surfaces) for another pilot, or a plugin like TCAS Trainer, to render at a distance. There's no cockpit, no systems, no switches, no displays — and, unlike the aircraft you fly yourself, no flight model behind it at all. X-Plane has to continuously simulate your own aircraft in full (aerodynamics, engines, systems) to keep you flying; a CSL model is simply moved from point A to point B by whichever plugin is drawing it. That's why TCAS Trainer (and every other traffic plugin) can render CSL aircraft cheaply — it's only ever positioning and animating a shell, never simulating a flight.

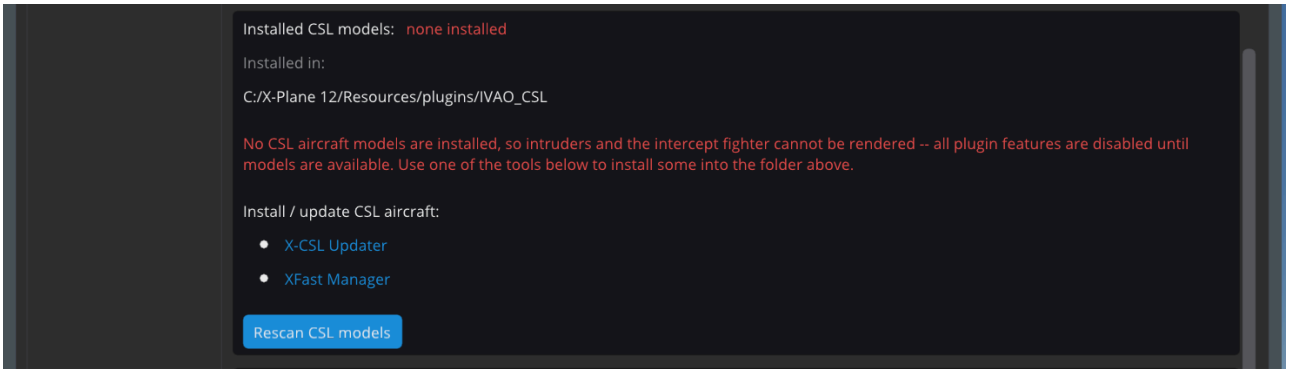
Apart from the single Santa Claus model of the Christmas edition (see The Christmas Edition), TCAS Trainer doesn't ship any CSL models itself (they're large, separately-distributed asset packages) — without at least one package installed, it has no aircraft to draw at all, and disables every feature until one becomes available. Models install as a sibling folder next to TCAS Trainer itself: `Resources/plugins/IVAO_CSL`.

Two tools are commonly used to install and keep CSL packages up to date — links to both are on the General page itself:

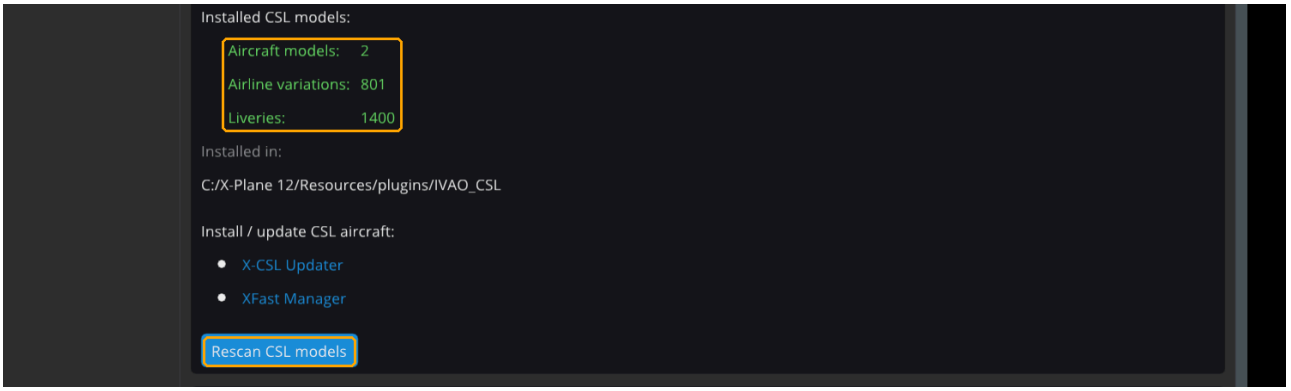
- X-CSL Updater (https://x-csl.ru/downloads)
- XFast Manager (https://forums.x-plane.org/files/file/98845-xfast-manager-one-app-to-auto-install-update-and-organize-everything-in-x-plane/)

After installing or updating models while X-Plane is already running, click **Rescan CSL models** rather than restarting X-Plane — TCAS Trainer re-scans the folder immediately and the installed count updates as soon as the scan completes. Rescanning only ever *adds* newly-found models; it does not remove models whose files you deleted since the last scan (restart X-Plane for that).

Before any package is installed, the General page's CSL section looks like this:



Once a package is installed (or after clicking **Rescan CSL models** — see below), the same section shows what's actually available:



Suggested packages: for realistic airline traffic to use as intruders, a general-purpose CSL package such as the A320 or the B738 covers the common airliner types you're most likely to encounter for real, and is a good default choice. For the intercept fighter, look for a freeware military or warbird CSL package — both tools below catalog a range of these alongside the usual airline sets.

The Christmas Edition

The **Christmas edition** of TCAS Trainer comes with a single CSL model: **Santa Claus** (ICAO type `SSLH`; a sleigh pulled by animated reindeer). It is installed in the plugin's own `CSL` folder (`Resources/plugins/TCASTrainer/CSL`), which TCAS Trainer always searches, so it appears in the **Type** lists of the intruders and the intercept fighter without any further installation. It is unlocked by the `SANTA` license feature (see Licensing).

This is the only model the Christmas edition includes. To fly intruders that look like airliners or other aircraft, install a CSL package as described in Installing CSL Aircraft Models; the Santa Claus model works alongside them.

External Visual Computers (Networked Setups)

If your setup uses one or more separate computers purely as external visuals — for example a dedicated "outside view" machine networked to your main X-Plane instance — TCAS Trainer's synthetic traffic won't automatically appear on them. TCAS Trainer renders every intruder and the intercept fighter through XPMP2, the same multiplayer-aircraft library used across the X-Plane traffic ecosystem, and XPMP2 only draws aircraft on the computer TCAS Trainer itself is running on.

To see the same traffic on a networked external-visual computer, install and run the **XPMP2 Remote Client** there (it needs its own copy of the same CSL models installed too — see above). It receives aircraft data from TCAS Trainer, over the network, and renders it locally in sync with the master computer.

- XPMP2 Remote Client setup guide (https://twinfan.gitbook.io/livetraffic/setup/installation/xpmp2-remote-client)
- XPMP2 Remote Client documentation (https://twinfan.github.io/XPMP2/Remote.html)

A few things worth knowing about such a setup:

- **The external computer only draws the aircraft.** TCAS Trainer, its encounter logic, the TCAS/ND display and the TCAS alerts all stay on the main (master) X-Plane. Whatever you fly and see on the TCAS display is unchanged; the Remote Client just shows the same intruders and fighter in the outside view.
- **Install the same CSL models on each external computer**, in the Remote Client's own `XPMP2-Remote/Resources` folder — including the `SSLH` Santa Claus package if you want to see it there. The `SANTA` license only controls which aircraft types the *main* computer offers; the external computers simply draw whatever they are told to.
- **The network must forward UDP multicast.** Normally nothing needs to be configured: the computers find each other automatically. The Remote Client's documentation (linked above) describes the optional settings for unusual networks,

such as different multicast addresses or ports; it does not list port numbers or firewall rules, so if your firewall blocks the traffic, check there first.

- **Run the Remote Client only on the external computers.** It asks its own X-Plane for TCAS control as soon as it starts, which does not interfere with the main computer (each X-Plane has its own). Installed on the *same* computer as TCAS Trainer, it would compete with TCAS Trainer for TCAS like any other plugin — see Running Alongside Other Traffic Plugins.

Running Alongside Other Traffic Plugins

TCAS Trainer can run together with other plugins that draw aircraft, such as LiveTraffic or an online-network client like xPilot. They all use the same multiplayer-aircraft library, so their aircraft are drawn side by side without conflict.

There is one limit, and it comes from X-Plane itself: **only one plugin at a time can drive X-Plane's TCAS display.** TCAS Trainer takes that role only while at least one intruder or the intercept fighter is active, and gives it back when the last one is deactivated.

If another plugin already holds TCAS, TCAS Trainer cannot take it away. Other plugins generally do not hand TCAS over on request — X-Plane's own guidance is that real, human-flown traffic takes precedence over generated traffic. In that case TCAS Trainer shows a red message at the top of every screen:

> **Waiting for plugin LiveTraffic to release TCAS**

No intruder appears until TCAS Trainer can drive TCAS; it asks the other plugin only once, and takes over by itself as soon as the other plugin lets go. The message disappears when TCAS Trainer has control, or when no intruder or fighter is active any more. The name shown is the one the other plugin registered with X-Plane.

To release TCAS in the plugin that holds it (as of the versions reviewed — check the other plugin's own documentation):

- **LiveTraffic** — switch off the **TCAS controlled** menu item (its planes keep flying; they just leave the TCAS display). To stop LiveTraffic from taking TCAS at startup, enable **TCAS on request only** in its settings. LiveTraffic shows a message when another plugin asks for TCAS, but never gives it up by itself.
- **xPilot** — it requests TCAS control at startup, whether or not you are connected, and ignores requests from other plugins. Use its **Release TCAS Control** menu item (or the `xpilot/toggle_tcas` command), or disable TCAS in xPilot's settings.
- **IVAO Altitude and other online clients** — they normally keep TCAS while you are connected to the network. Disconnect, or use that client's own TCAS option if it has one.

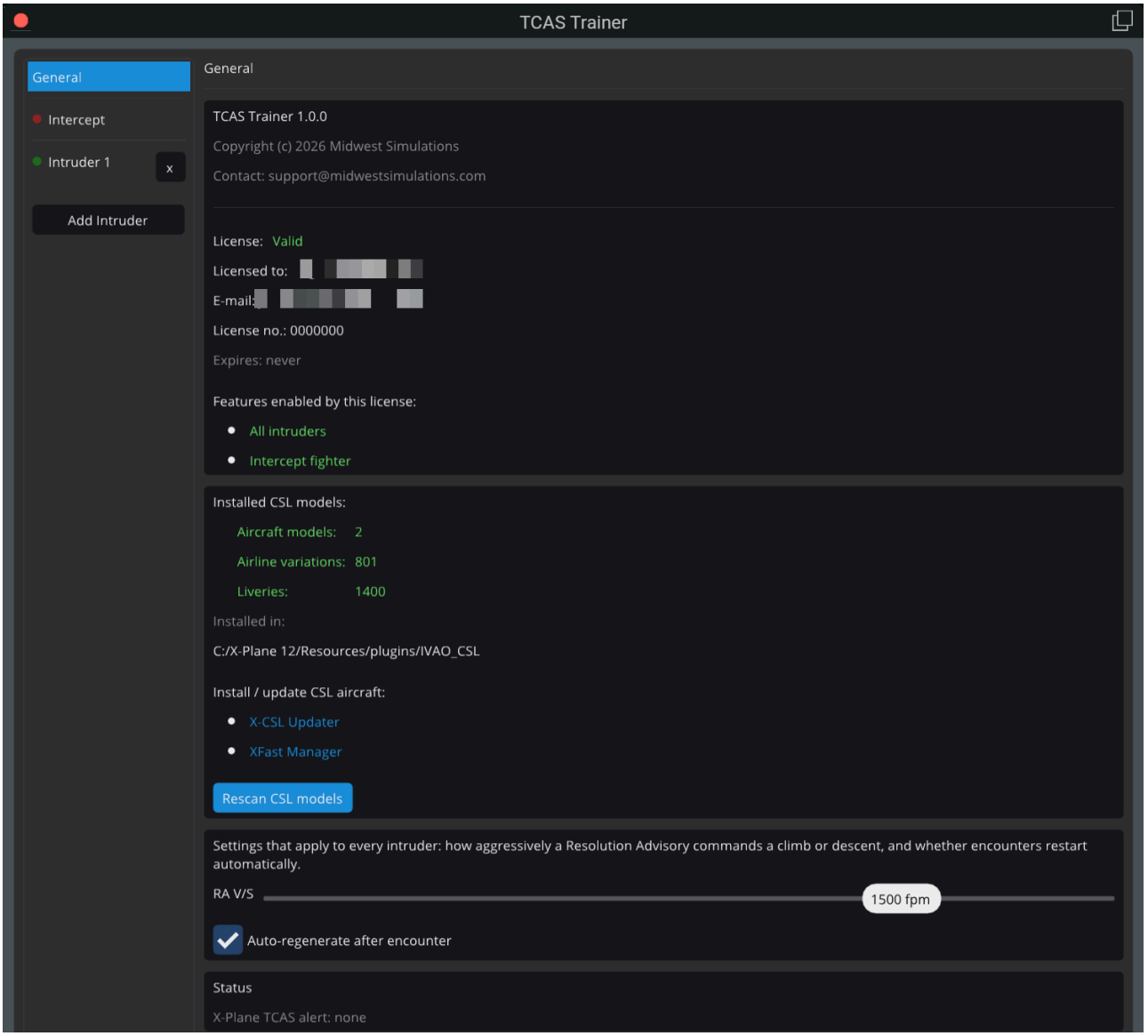
When you finish training, deactivate your intruders so TCAS Trainer releases TCAS, then re-enable it in the other plugin (for example **Request TCAS Control** in xPilot, or **TCAS controlled** in LiveTraffic).

Conversely, if another plugin asks for TCAS while TCAS Trainer holds it (for example when you switch on **TCAS controlled** in LiveTraffic during a session), TCAS Trainer gives it up and shows the same waiting message.

The **XPMP2 Remote Client** is such a plugin too: it requests TCAS as soon as it starts. Use it on separate external-visual computers (see External Visual Computers), where it does not interfere with the main computer. Its optional "TCAS concentrator" mode, which merges the traffic of several XPMP2-based plugins into one TCAS feed, has not been tested with TCAS Trainer, and TCAS Trainer does not run intruders without having TCAS control itself.

The General Page

With licensing and CSL models both taken care of, the General page becomes TCAS Trainer's home base — version and license status, CSL model status, settings that apply to every intruder, and an overall status line:



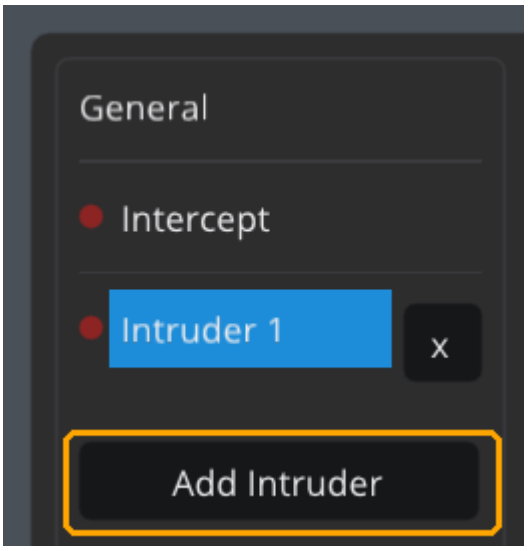
From top to bottom:

- **Version, copyright, and license status** — including exactly which features your license enables (see Licensing)
- **CSL model status** — installed model counts and location, links to maintenance tools, and the **Rescan CSL models** button (see Installing CSL Aircraft Models)
- **Shared settings**, applying to every intruder at once:
  - **RA V/S** — the vertical speed (0–2000 fpm) that an intruder will adopt when he receives a Resolution Advisory
  - **Auto-regenerate after encounter** — when enabled, 20 seconds after an intruder has flown past its closest point of approach automatically respawns at the defined initial position
- **Status** — X-Plane's own native TCAS alert state (`none` / `ACTIVE`), confirming TCAS Trainer is genuinely driving X-Plane's real TCAS system, not just its own internal display

The sidebar on the left lists **General**, **Intercept** (the fighter), and one entry per allocated intruder — a colored dot (red = inactive, green = active) shows each one's current state at a glance, and an **Add Intruder** button allocates a new slot.

Configuring and Using Intruders

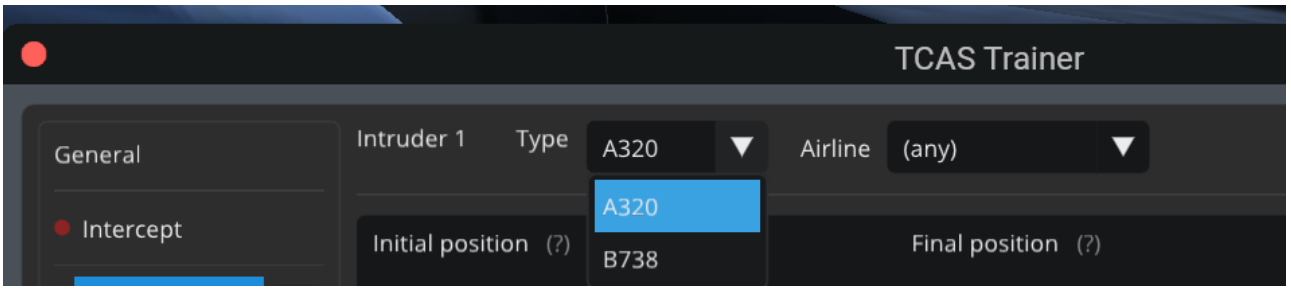
Each intruder is configured on its own page, reached by clicking its entry in the sidebar. Click **Add Intruder** to allocate a new slot (up to 8):



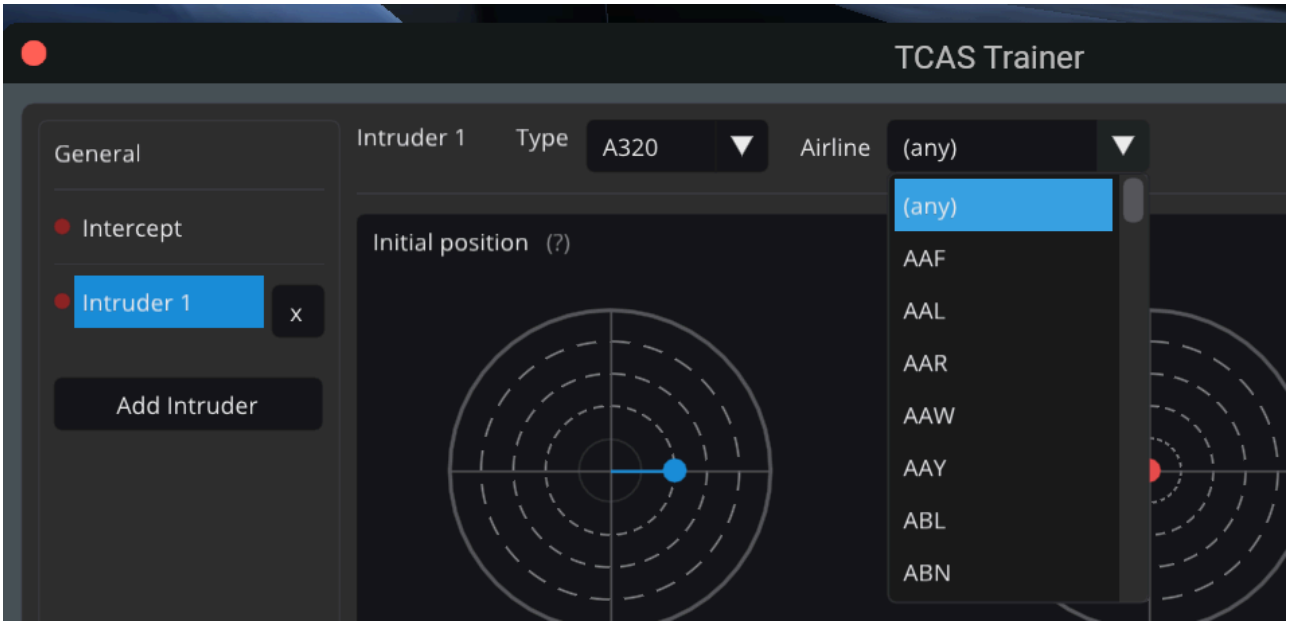
Add Intruder only works with the "all intruders" license feature. A license granting just the single-intruder feature pre-allocates exactly one slot (Intruder 1) and has no way to add more — allocating additional slots needs the broader `INTRUDERS` feature. See Licensing for the difference between the two.

Aircraft Type and Airline

At the top of each intruder's page, choose its **Type** (aircraft ICAO type, drawn from your installed CSL models) and **Airline** (a specific livery, or `(any)` for a random one matching the chosen type):



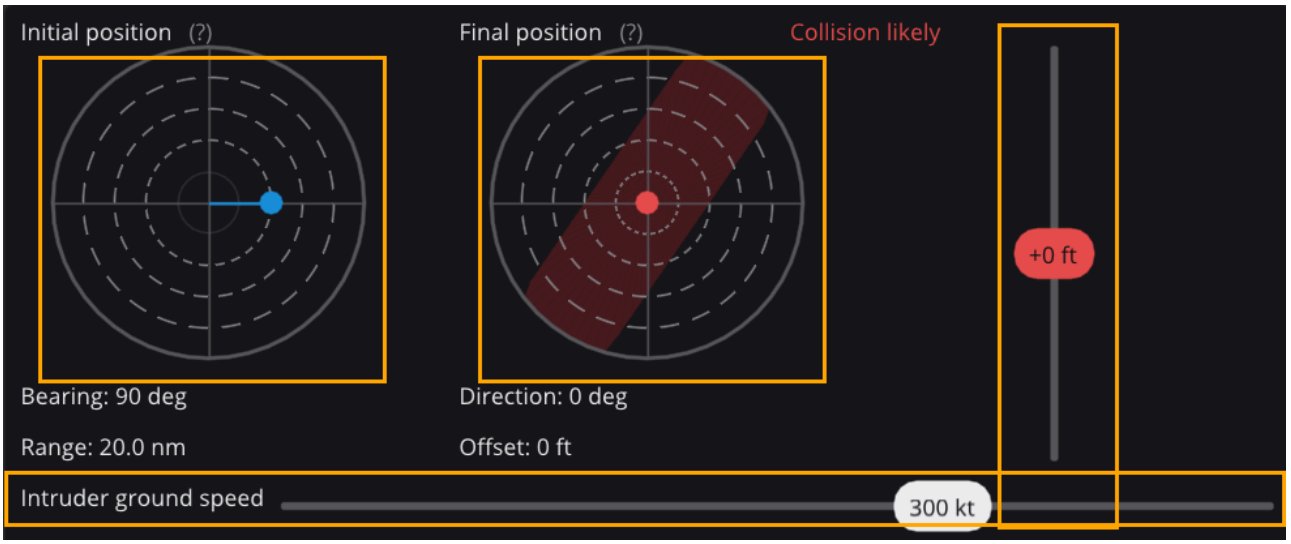
The **Type** dropdown lists every aircraft type your installed CSL models cover.



The **Airline** dropdown lists every livery installed for the currently selected type, plus `(any)` at the top for a random pick.

Encounter Geometry

The heart of an intruder's configuration is two paired dials, plus a ground speed slider:



Initial position (left dial) — this is a control, not a map. It's tempting to read the dot's position as "the intruder is sitting right there, that many miles away, in that compass direction from me" — that is *not* what it shows. The dial is simply a convenient way to edit two entirely independent numbers at once, using the dot's distance from center for one and its angle for the other:

- **Initial intruder range** — how far away (in a straight line) the intruder is from you at the exact moment it's created. Dragging the dot toward or away from the center changes only this number.
- **Bearing at encounter** — the angle, relative to *your own nose* (not a compass direction), at which the intruder's flight path will cross yours when you actually meet. 0° means it's on a reciprocal course, headed straight at you; 90° means it crosses your path from your right, like traffic passing left-to-right ahead of you; 180° means it's overtaking you (or being overtaken) from directly behind; 270° means it crosses from your left. Dragging the dot around the dial changes only this number.

TCAS Trainer works out where to actually place the intruder — and which way to point it — by solving *backward* from these two numbers together with your current speed and track and the intruder's own chosen ground speed: it first works out where you and the intruder will actually meet, then walks the intruder's spawn point backward along its own course from there, adjusting until the resulting distance between you and that spawn point matches your configured range. The same Bearing can therefore produce a very different-looking spawn *position* depending on your current heading and speed at the moment — which is exactly right, since Bearing describes the crossing geometry at the encounter, not a fixed point in the sky.

Worked example: with the default configuration (Range = 20.0 nm, Bearing = 90°), the intruder spawns 20 nm away from you right now, on a course that will bring it across your nose from the right — *not* 20 nm due east of you, unless your own track happens to be due north at that moment.

The other controls on this page:

- **Final position** (right dial + vertical slider) — where the intruder actually passes you at its closest point. The dial's **Direction** sets how far to the side it passes and in which direction (same 0°/90°/180°/270° convention as above, always relative to *your* track — 0° means the encounter lands further along your own track rather than beside you); the vertical slider sets how far **above or below** you it passes (−1000 to +1000 ft).
- **Intruder ground speed** — 100–550 kt, independent of the geometry above; TCAS Trainer times the intruder's spawn so it reaches the configured meeting point regardless of the speed you choose.

The red-shaded region on the Final position dial marks exactly how close is too close, at every direction — not a plain 100 m circle, but the true closest-approach boundary for the current Bearing and speeds, computed from the actual closing geometry between you and the intruder. It stretches out along the direction you and the intruder are actually closing with each other (an offset placed almost exactly on that axis tolerates a much larger distance before it's actually dangerous) and pinches in to roughly 100 m anywhere perpendicular to that axis (an offset there is dangerous even at what looks like a comfortable distance). Exactly where that axis points on the dial isn't fixed — it depends on your Bearing and both aircraft's speeds, so it's only "ahead/behind" or "abeam" for particular geometries, not in general. If the currently configured Direction/Offset falls inside that shaded region *and* the altitude offset is within roughly 100 ft — an actual collision, not just a close TCAS encounter — the dial's dot and the altitude slider's grab turn red and the page displays **"Collision likely"**, so you can see immediately if a geometry you're configuring is too aggressive.

Reaction and Collision Options

Checkboxes just below the dials:

- **React to RA (climb/descend on its own RA)** — when enabled, the intruder actually flies its own Resolution Advisory (climbing or descending at the configured RA V/S) once one fires against it, instead of holding its original course.
- **TA only (climb/descend before RA)** — when enabled, this intruder never reaches a Resolution Advisory at all. Instead, once it's halfway from the Traffic Advisory to where the RA would fire, it climbs or descends away — complementary sense, like a real RA — at *double* the RA V/S rate configured on the General page. Useful for practicing TA recognition/response on its own, without an RA following it every time.
- **Detect collision** — enabled by default; governs whether this intruder's proximity is checked against the collision thresholds described above at all.

Intruder Flight Behavior

Once spawned, an intruder isn't just moved along a fixed, precomputed track — it continuously re-solves its path toward the configured encounter, for as long as it's active:

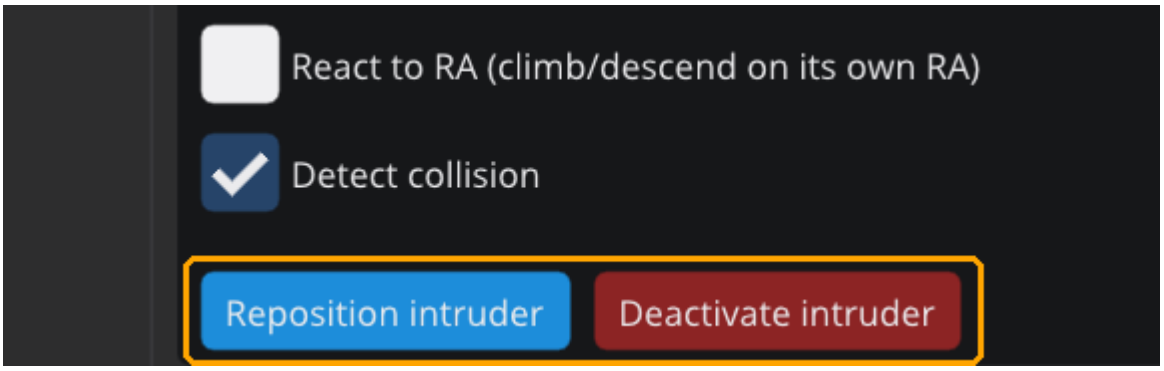
- **Heading** is fixed the moment the intruder spawns, for its entire life — it never turns.

- **Speed** is continuously adjusted so the intruder still reaches the configured encounter — even if you speed up, slow down, or change heading after it has spawned. If your course changes enough that the intruder could no longer reach you at any achievable speed, it gives up and deactivates itself after a short countdown (`xtcas/status/unreachable_countdown_sec` counts this down, if you're watching via dataref).
- **Altitude** tracks your own — the intruder climbs or descends to follow you — right up until TCAS Trainer's own detection logic raises a Resolution Advisory against it (see TCAS Trainer does not fly your aircraft for why that decision is independent of your own aircraft's TCAS). From that moment, its vertical path depends on the **React to RA** checkbox above:
  - **Checked** — the intruder flies its own RA, climbing or descending at the **RA V/S** rate configured on the General page.
  - **Unchecked** — the intruder simply holds the altitude it had at the moment its RA fired.

  Either way, the intruder never follows *your* RA-driven climb or descend — so an intruder that is generating an RA for you won't chase you into your own avoidance maneuver.

Activating an Intruder

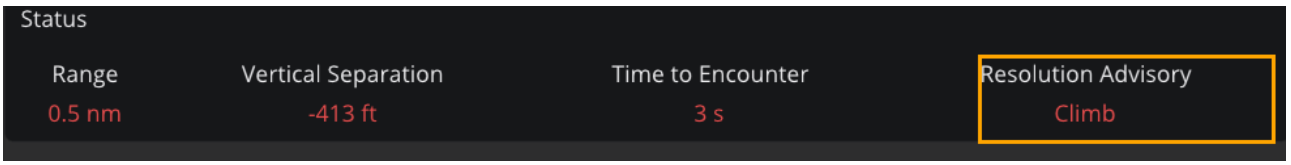
Click **Activate intruder** to spawn it at the configured geometry. Once active, the same button area offers **Reposition intruder** (re-spawn at the current configuration, from scratch) and **Deactivate intruder** (remove it):



Every other setting on this page (geometry, speed, type/airline, the checkboxes) is saved automatically and restored the next time you load the plugin — but **whether a slot is active is not**. Every intruder (and the intercept fighter, see below) always starts deactivated on a fresh session, regardless of how you left it. This is deliberate: a saved encounter is very unlikely to still make sense once you're in a different position, on a different flight, so TCAS Trainer never resurrects one behind your back — you always choose when to start again.

Reading the Status

Once active, the **Status** section at the bottom of the page shows the live encounter — Range, Vertical Separation, Time to Encounter, Speed, and the current Resolution Advisory (`None`, `Climb`, or `Descend`), all in red once an RA is active:

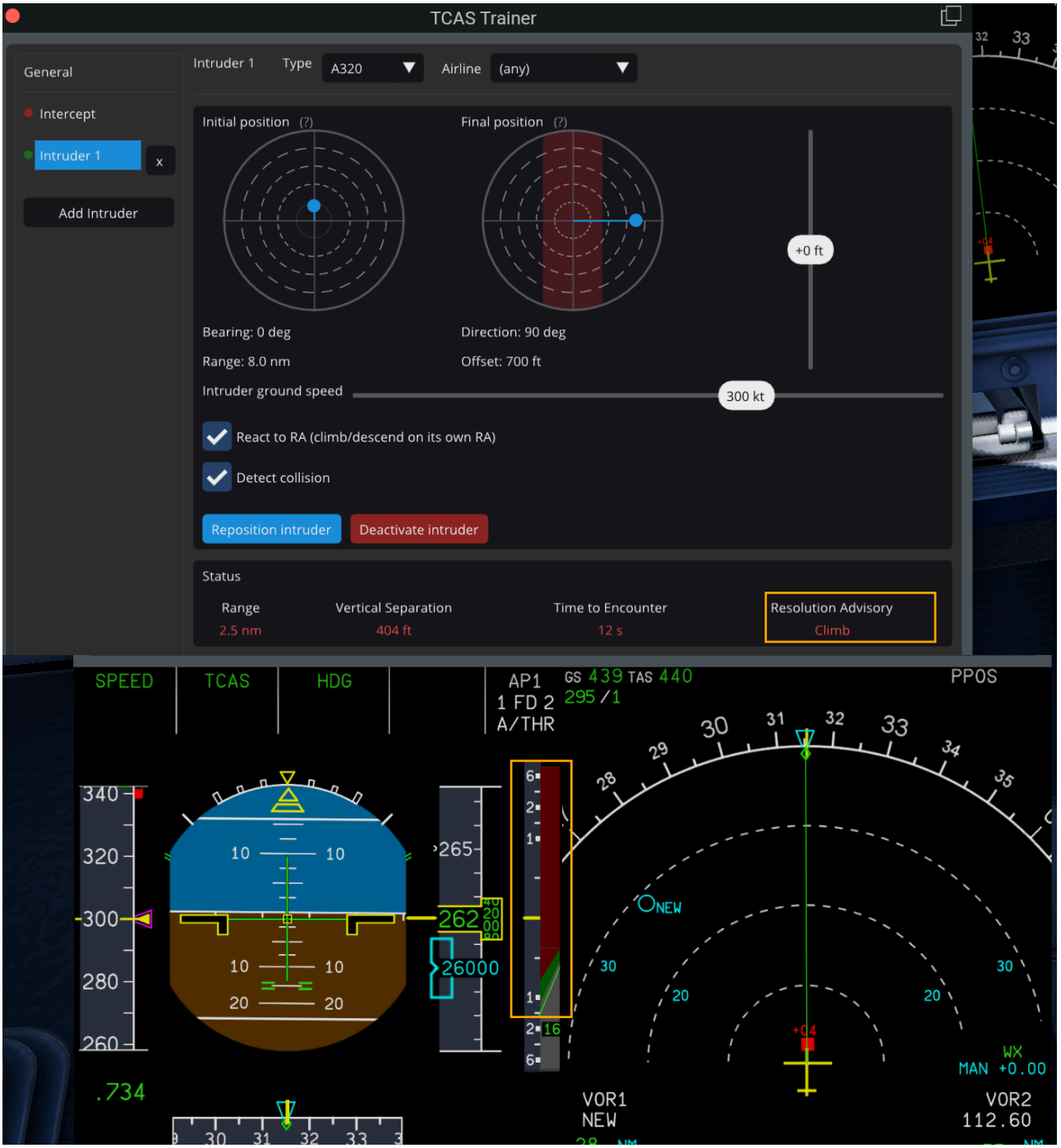


One subtlety: the sense shown here (`Climb` / `Descend`) is the sense given to the **intruder**, not to you — a real TCAS always coordinates complementary senses so the two aircraft diverge instead of both moving the same way, so your own aircraft's actual RA is the opposite of whatever this field says. It only reflects something the intruder actually *does*, though, if

React to RA is also checked for it (see Intruder Flight Behavior) — otherwise the intruder just holds its pre-RA altitude regardless of this field, so it reads **n/a** instead of a specific sense.

For a **TA only** intruder (see Reaction and Collision Options), this last field relabels itself to **Fleeing (TA only)** once it starts climbing/descending away — that intruder never reaches an actual RA, so showing it under "Resolution Advisory" would be misleading. Unlike the ordinary RA sense above, this one always reflects what the intruder is actually doing, regardless of the React to RA checkbox.

Because TCAS Trainer drives X-Plane's own TCAS system directly, this encounter also plays out on your aircraft's real instruments, not just in the plugin's own status readout. You can see your own aircraft's real, complementary RA for yourself: the TCAS annunciation and the red/green vertical-speed bands on your PFD, and the intruder drawn as a colored traffic symbol on your ND:



This particular PFD/ND rendering is specific to the ToLiss A320 used to take this screenshot. Every aircraft add-on implements its own TCAS/PFD/ND display on top of X-Plane's shared TCAS datarefs, so the exact symbols and colors you see will depend on which aircraft you fly; only the underlying TCAS data (and the fact that it's genuinely being driven) is universal.



Multiple Intruders

Every intruder slot is independent — different aircraft, different geometry, active or not, all at once (license permitting). A red dot in the sidebar marks an inactive slot, green marks an active one; click the small × next to a slot to remove it entirely.

Configuring and Using Fighter Intercept

The intercept fighter is a second, independent feature: one aircraft that flies up from behind and holds a tight formation position off your aircraft, at a configurable direction, distance, and altitude offset. Unlike an intruder, the fighter never participates in TCAS — it will never trigger a Resolution Advisory, however close it holds.

Aircraft Type and Airline

The **Intercept** page uses the exact same **Type**/**Airline** controls as an intruder (see Aircraft Type and Airline) — choose any installed CSL model, fighter jet or otherwise.

Hold Position

A single dial plus a vertical slider set where the fighter holds station, both relative to your own track (same 0°/90°/180°/270° convention as an intruder's final position — see Encounter Geometry):



The fighter always spawns behind you, at a range timed to close over roughly 30 seconds, before settling into the configured hold position.

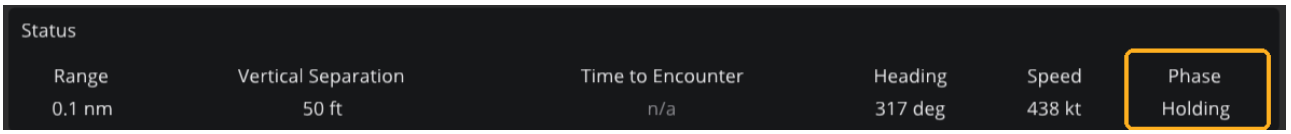
Activating, Repositioning, and Deactivating

Click **Activate intercept fighter** to spawn it. While active, the same area offers **Reposition intercept fighter** (fly a fresh approach to the current hold position) and **Deactivate intercept fighter** (send it away).

Safety gate: the intercept fighter requires at least 150 kt groundspeed and 200 ft AGL to activate — formation-flying an aircraft that close is only appropriate well clear of the ground. Trying to activate below either threshold does nothing except show an explanatory message in place of the button. The same threshold applies continuously, not just at activation: if an already-active fighter's conditions drop below it — most likely a go-around, or simply slowing down and descending toward landing — it automatically departs on its own, exactly as if you'd clicked **Deactivate intercept fighter** yourself (see Reading the Status below for what that departure looks like).

Reading the Status

The Status row reports Range, Vertical Separation, Time to Encounter (while still approaching), Heading, Speed, and the fighter's current **Phase**:



Phase	Meaning
`Approaching`	Flying toward the hold position
`Holding`	Formatted on station at the configured position
`Advancing`	Departing forward, ahead of you, after deactivation
`Breaking`	Peeling away to depart after advancing

A fighter holding tight formation, visible out the cockpit window:



Dataref and Command Reference

Every control in the configuration window is backed by a dataref (and, for actions, a command), so TCAS Trainer can be driven entirely from another plugin, a hardware panel, or a scripted scenario without ever opening its own window.

Conventions:

- Per-intruder items are named `xtcas/intruder/N/...` for commands (`N` = 1–8), or are elements of an 8-element array dataref indexed **0-based** (element 0 = "Intruder 1") for `xtcas/config/...` and `xtcas/status/...` array datarefs.
- All directions (`bearing_deg`, `*_dir_deg`) use the same convention throughout: 0° = ahead / further along the ownship's track, 90° = right, 180° = behind, 270° = left, clockwise.
- Distances are nautical miles (`_nm`) or feet (`_ft`) as named; speeds are knots (`_kt`); vertical rates are feet per minute (`_fpm`); durations are seconds (`_sec`).

Global Configuration Datarefs

Dataref	Type	Description
`xtcas/config/num_targets`	int	Number of currently-allocated intruder slots (grows as you click **Add Intruder**)
`xtcas/config/ra_rate_fpm`	float	Resolution Advisory vertical speed, applied to every intruder (0–2000)
`xtcas/config/auto_regenerate`	int (bool)	Whether a passed encounter automatically respawns fresh
`xtcas/config/csl_rescan_requested`	int (bool)	One-shot: write 1 to trigger a CSL folder rescan (self-clears once processed)
`xtcas/config/window_visible`	int (bool)	Whether the configuration window is currently shown — mirrors the **Show/Hide Configuration** menu item and `xtcas/configuration/*` commands, and persists across sessions

Per-Intruder Configuration Datarefs

Each of the following is an 8-element array dataref (index 0 = Intruder 1 … index 7 = Intruder 8), except the ICAO type/airline, which are separate per-slot scalar string datarefs (see the table below).

Dataref	Type	Description
`xtcas/config/enabled`	int[8] (bool)	Whether this slot is active
`xtcas/config/distance_nm`	float[8]	Initial range at spawn
`xtcas/config/bearing_deg`	float[8]	Bearing at encounter (see Encounter Geometry)
`xtcas/config/altitude_offset_ft`	float[8]	Vertical offset at closest approach (−1000…+1000)
`xtcas/config/speed_kt`	float[8]	Intruder ground speed (100–550)

Dataref	Type	Description
`xtcas/config/ra_reaction_enabled`	int[8] (bool)	Whether the intruder flies its own RA
`xtcas/config/ta_only`	int[8] (bool)	Whether this intruder flies away at the TA/RA midpoint instead of ever reaching an RA (double the RA V/S rate) — see Reaction and Collision Options
`xtcas/config/lateral_offset_dir_deg`	float[8]	Direction of closest-approach offset from your track
`xtcas/config/lateral_offset_ft`	float[8]	Distance of closest-approach offset (0–1000)
`xtcas/config/collision_detection_enabled`	int[8] (bool)	Whether this slot is checked against the collision thresholds
`xtcas/config/reposition_requested`	int[8] (bool)	One-shot: write 1 to respawn this slot fresh
`xtcas/intruder/N/icao_type`	string	ICAO aircraft type for intruder N (1–8)
`xtcas/intruder/N/airline`	string	ICAO airline code for intruder N (empty = any)

Fighter Configuration Datarefs

Dataref	Type	Description
`xtcas/config/fighter/enabled`	int (bool)	Whether the fighter is active
`xtcas/config/fighter/position_dir_deg`	float	Hold-position direction, relative to your track
`xtcas/config/fighter/position_distance_ft`	float	Hold-position distance (0–1000)
`xtcas/config/fighter/altitude_offset_ft`	float	Hold-position vertical offset (–1000…+1000)
`xtcas/config/fighter/reposition_requested`	int (bool)	One-shot: write 1 to fly a fresh approach
`xtcas/fighter/icao_type`	string	ICAO aircraft type for the fighter
`xtcas/fighter/airline`	string	ICAO airline code for the fighter (empty = any)

Status Datarefs (Read-Only)

Per-intruder status is again an 8-element array (index 0 = Intruder 1):

Dataref	Type	Description
`xtcas/status/range_nm`	float[8]	Current range, or –1 if not applicable
`xtcas/status/vertical_sep_ft`	float[8]	Current vertical separation
`xtcas/status/time_to_cpa_sec`	float[8]	Time to closest point of approach, or –1
`xtcas/status/ra_active`	int[8] (bool)	Whether a Resolution Advisory is currently active
`xtcas/status/ra_sense`	int[8]	`0` = none, `1` = Climb, `2` = Descend
`xtcas/status/ta_only_fleeing`	int[8]	For a `ta_only` intruder: `0` = not yet fleeing, `1` = climbing away, `2` = descending away

Dataref	Type	Description
`xtcas/status/unreachable_countdown_sec`	float[8]	Seconds remaining before an unreachable encounter is discarded, or −1
`xtcas/status/latitude_deg` / `longitude_deg` / `altitude_ft`	float[8]	Live position
`xtcas/status/vertical_speed_fpm` / `heading_deg` / `ground_speed_kt` / `roll_deg`	float[8]	Live kinematics
`xtcas/status/xp_tcas_alert`	int (bool)	X-Plane's own native TCAS alert state — confirms TCAS Trainer is genuinely driving X-Plane's real TCAS, not just its own display
`xtcas/status/collision_horizontal_ft` / `collision_vertical_ft`	float	The live thresholds "Collision likely" and the dataref above are checked against
`xtcas/status/csl_path`	string	Absolute path CSL models are loaded from
`xtcas/status/tcas_blocked_by`	string	Name of the plugin TCAS Trainer is waiting for to release X-Plane's TCAS control (empty when not waiting) — see Running Alongside Other Traffic Plugins

Fighter status is scalar (there is only ever one fighter):

Dataref	Type	Description
`xtcas/status/fighter/active`	int (bool)	Whether the fighter is currently active
`xtcas/status/fighter/range_nm` / `vertical_sep_ft` / `time_to_cpa_sec`	float	Live encounter metrics
`xtcas/status/fighter/phase`	int	`0` = Approaching, `1` = Holding, `2` = Advancing, `3` = Breaking
`xtcas/status/fighter/heading_deg` / `speed_kt` / `roll_deg` / `vertical_speed_fpm`	float	Live kinematics
`xtcas/status/fighter/latitude_deg` / `longitude_deg` / `altitude_ft`	float	Live position

Commands

Command	Description
`xtcas/configuration/show`	Show the configuration window
`xtcas/configuration/hide`	Hide the configuration window
`xtcas/configuration/toggle`	Show or hide the configuration window
`xtcas/intruder/N/activate`	Activate intruder N (1–8), allocating the slot first if needed
`xtcas/intruder/N/deactivate`	Deactivate intruder N
`xtcas/intruder/N/reposition`	Respawn intruder N fresh at its current configuration

Command	Description
`xtcas/fighter/activate`	Activate the intercept fighter
`xtcas/fighter/deactivate`	Deactivate the intercept fighter
`xtcas/fighter/reposition`	Fly the intercept fighter a fresh approach
`xtcas/rescan_csl`	Re-scan the CSL folder for newly installed aircraft models

Every command and dataref above is subject to the same license gating as the configuration window itself (see Licensing) — a command or dataref write that would activate an unlicensed feature is silently refused.