



TRANSPONDER

1. Introduction

A transponder (short-for transmitter-responder) is an inboard electronic device that produces a response when it receives a radio-frequency interrogation. It assists ATC in identifying aircrafts on radar scope and other aircraft's collision avoidance systems.

Depending on interrogation mode, transponders can provide identification code, aircraft position, pressure altitude, call sign and some other information.

The ATC radar sends a 1030 MHz radio frequency interrogative pulsed signal. The aircraft answers on 1090 MHz radiofrequency with another pulsed signal.

After decoding, the transmitted signal is used, on ATC radar, to identify the aircraft (code and/or call sign) and display relevant information (azimuth, altitude, speed, flight path).

2. Transponder modes

2.1. Transponder mode

Several different RF communication protocols have been standardized for civilian aviation transponders:

- **Mode A** equipment transmits an identifying code only,
- **Mode C** provides identifying code and aircraft pressure altitude,
- **Mode S** (for selective) provides multiple information formats to a selective interrogation (data exchange), including call sign; it is designed to help avoiding over interrogation and to allow automatic collision avoidance.

2.2. Equipment code in flight plan

Alphabetic codes are used on ICAO flight plan forms to aid ATC personnel in their handling of aircraft:

- **N** = No Transponder on board or equipment unserviceable
- **A** = Transponder - Mode A – 4 digits, 4096 codes
- **C** = Transponder - Mode C – 4096 codes and with pressure altitude reporting
- **X** = Transponder - Mode S – with neither aircraft identification nor pressure altitude capability
- **P** = Transponder - Mode S – with pressure altitude but without aircraft identification capability
- **I** = Transponder - Mode S – without pressure altitude but with aircraft identification capability
- **S** = Transponder - Mode S – with both pressure and aircraft identification capability

The transponder mode S is the most widely used mode. (IFR Flights)

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3. Transponder settings

3.1. Transponder status in real life

A transponder switch usually has several positions:

- OFF
- STBY
- ON
- ALT
- TA
- TA/RA



The “**STBY**” function will power the transponder and make it ready for operation (warming up).

The “**ON**” function will only send primary information to the radar that is code and position.

The “**ALT**” function (MODE C) will additionally transmit altitude information.

Functions such as “**TA**” and a “**TA/RA**” will provide collision avoidance and traffic advisory resolution.



4. Transponder IDENT

All mode A, C, and S transponders include an IDENT button, which activates a special function known as IDENT, short for identify in order to help air traffic controller to locate an aircraft.

Squawk Ident button on a real instrument:



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5. Transponder codes

Transponder transmission usually uses a discrete code in order to identify the flight. For certain type of flights and/or situations, specific transponder codes are used.

5.1. Number of codes

Squawk codes are four-digit octal numbers. The dials on a transponder read from 0 to 7, inclusive. Thus the lowest possible squawk is **0000** and the highest is **7777**. Four octal digits can represent up to 4096 different codes, which is why such transponders are often called "4096 code transponders".



5.2. Transponder 7700 = the emergency code

There is one unique worldwide emergency code which is 7700.

When a pilot is facing an emergency situation, he should set his transponder code to 7700 as soon as possible unless otherwise instructed.



An ATC can request a pilot to squawk 7700 if he declares an **emergency or distress** situation (**MAYDAY**). If the pilot is facing a failure, this code shall not be used.

The pilot will dial up the emergency code when he has time to do it. Handling the aircraft has the highest priority.

When the aircraft is landed safely or not, an air traffic controller can ask the pilot to setup a normal code if the emergency is terminated.

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5.3. Transponder 7600 = the radio failure code

There is one unique worldwide radio failure code which is 7600.

This code is used when no bidirectional communication can be done between an aircraft and an air traffic controller.



This code is mainly used when a pilot is facing technical problems with his connection or for training purpose.

On IVAO network, be aware that, if a pilot can't speak by voice with the air traffic controller, pilot and ATC must try to communicate by text as far as possible.

5.4. Transponder 7500 = the hi-jacking code

There is one unique worldwide hi-jacking code which is 7500.

The use of this code is strictly prohibited on the IVAO network. (R&R 6.4.1)

“Special operation including simulation of terrorism and act of wars are prohibited. Although armed conflicts do exist in the real world, we do not allow the simulation of any form of aggression or violence on the IVAO network.”



(This image was created with special authorization from a supervisor in order to make this documentation).

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5.5. Non-controlled VFR code

Depending on local R&R, several codes can be used for uncontrolled VFR flights; the most frequently used are:

- **1200** : USA and Canada standard squawk code used when no other has been assigned
- **7000** : ICAO VFR standard squawk code when no other code has been assigned



You can find some other default code depending of local regulations (ex 1400, 3000).

5.6. Non-controlled IFR code

There is one unique worldwide for non-controlled IFR flights code which is 2000

It is the responsibility of the pilot in command to setup this code if he is not inside a controlled airspace.



5.7. Other codes

This is a list of some other codes:

- **0000**: this code shall not be used. It is a non-discrete mode A code. It is usually displayed on Ivap in case of some specific technical problems.
- **7777**: Non-discrete code used to test transponders and to check correctness of radar stations
- **74xx**: these codes are sometimes used for NATO special operations

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6. How to use Transponder as a pilot with IvAp

In phraseology, controllers and pilots use the term “squawk” as transponder code.

6.1. Transponder status with IvAp

The transponder has two settings on IVAO:

- **STBY** (associated with the orange spot)
- **TX** (associated with the green spot) can be considered as **ALT real mode**.



As a pilot in command, you must set your transponder position by yourself.

You must:

- Set transponder to **STDBY** position before connecting to the IVAO network
- Set transponder to **STDBY** position on apron and during taxiing
- Set transponder to **TX** position when entering the take-off runway
- Keep transponder to **TX** position while flying
- Set transponder to **STDBY** position after vacating the landing runway

For flying in formation, only the leader has to set his transponder on **TX**. The other aircrafts must maintain visual contact with the leader and will keep their transponder on the **STDBY** position.

There is no OFF mode in transponder equipment IVAO. Equipment lower position is always standby. In conclusion, you can't disappear from IVAO radar. TA and TA/RA mode are simulated by the IvAp TCAS system

6.2. Transponder mode with IvAp

IvAp shall be considered as a type mode S transponder.

Other mode can be programmed when filling the flight plan using adequate letter.

As a beginner, always fill equipment transponder with the letter S.

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6.3. Transponder IDENT button

When an air traffic controller wants to locate you quickly, he can ask a “transponder ident” to the pilot. Then, pilot will press the **IDENT** button of his IvAp interface.



Squawk IDENT button on IvAp

Note that pilot must press on the IDENT button only requested by a “transponder ident” procedure from a controller.

6.4. Transponder code

The pilot tunes the transponder code on the adequate instrument in the cockpit.

When entering a controlled zone, the pilot shall initiate the communication with the active controller. After first contact, the controller can give a new transponder code. The pilot shall tune it with no delay.

When leaving a controlled zone or when flying in non-controlled zone, a pilot shall tune the default transponder code in function of his navigation rules (2000 for IFR; 7000, 1200... for VFR).

As a pilot, if you don't know the default VFR transponder code of the country you overfly use **2000** as default transponder code.

If your aircraft fly outside any controlled zone, you are not allowed to tune a new code given by any air traffic controller except the non-controlled codes.

Example:

*You fly IFR in Uruguay in a non-controlled zone; a Brazilian controller outside your flight zone gives you 0535 transponder code => you must **keep 2000 or tune 2000** if you forget to tune it.*

*You fly IFR in Uruguay in a non-controlled zone; a Brazilian controller outside your flight zone gives you 2000 transponder code => you **must tune 2000** as this is a non-controlled transponder code.*

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7. How to use Transponder as a controller with IvAc

In phraseology, controllers and pilots use the term “squawk” as transponder code.

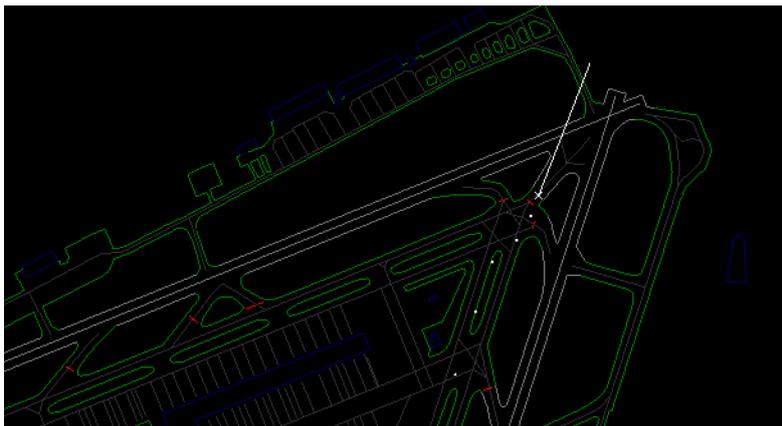
7.1. Transponder status with IvAc

It is the responsibility of the active controller to check that a pilot will follow the STDBY/TX position of his transponder.

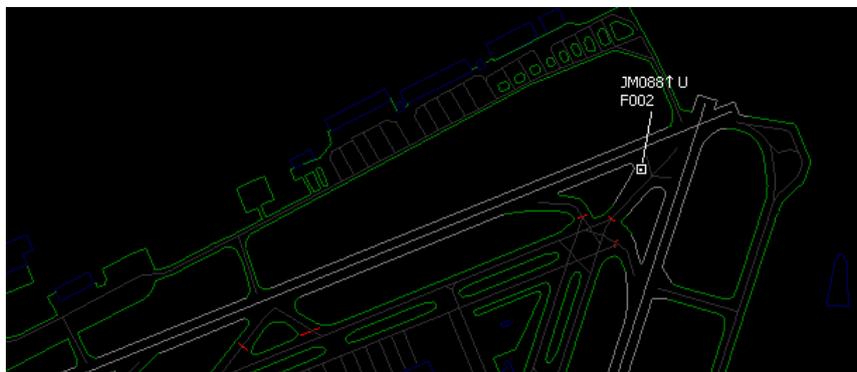
All pilot must :

- Set transponder to **STDBY** position before connecting to the IVAO network
- Set transponder to **STDBY** position on apron and during taxiing
- Set transponder to **TX** position when entering the take-off runway
- Keep transponder to **TX** position while flying
- Set transponder to **STDBY** position after vacating the landing runway

The figure below shows an aircraft taxiing in **STBY** mode on the radar screen:



The figure below shows an aircraft in **TX** mode on the radar screen.



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7.2. Transponder modes in IvAc

There are only two representations of the transponder mode:

- **Mode A** transponder with no pressure altitude information



This representation is also valid for **N**, **X** and **I** modes. The aircraft identification is always active in IvAp.

- **Mode C** or **Mode S** transponder with pressure altitude information



This representation is also valid for **P** mode. The aircraft identification is always active in IvAp.

7.3. Aircraft Identification with transponder

As an air traffic controller in large zone, you may not locate your aircraft quickly.

In order to speed up the localisation of your aircraft, the air traffic controller can use the IDENT procedure with giving "transponder IDENT" or "squawk IDENT" to the pilot.

With receiving a transponder IDENT request, a pilot will press the IDENT button on his instrument. When radar equipment receives the IDENT, it results in the aircraft's blip blinking on the radar scope.

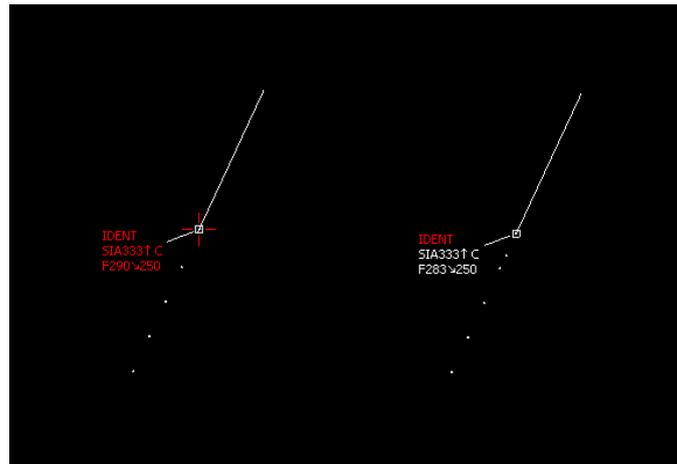
Note that IDENT should be performed on request of ATC only.

IDENT can also be used in case of a reported or suspected radio failure to determine if the failure is only one way and whether the pilot can still transmit or receive, but not both, e.g., "AirFrance 8542, if you read, squawk IDENT".

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The figure below shows the 2 aircraft state during the blinking IDENT on the radar screen.



7.4. Transponder code

In his area of control, an active controller is responsible to give a transponder code to all aircraft. It is the responsibility of the pilot in command to tune this code in their aircraft. There is no worldwide general rule to follow when giving a transponder code except the specific ones given in chapter 5.

Each country has its own transponder code allocation. Contact the ATC Operation Coordinator of the related division or ATC operation Director.

A controlled must give a unique discrete transponder code inside his area to any IFR flight with 2000 default transponder code.

Be aware as ATC, you cannot impose a particular code to an aircraft outside your airspace.

As an air traffic controller, you can give the code 2000 to an aircraft leaving your controlled zone to a non-controlled one.



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