

September 11, 1999

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Nicholas J. Talotta  
Technical Program Manager DOT/FAA  
FAA Technical Center  
Atlantic City Airport, NJ 08405

RE: Transponders becoming invisible

Dear Mr. Talotta,

I had a chance to speak with you briefly on the flight line at this year's EAA Airventure convention (I was the one proudly wearing my pink Oshkosh Tower ATC controller's shirt). I had a great time being part of FAA's ATC Team that helps to make AirVenture a safe operation.

Because of your interest in transponder operations, I promised that I would forward to you a report I wrote several years ago concerning aircraft not appearing on ARTCC controller scopes. As I was preparing to send that to you, I came across the report you wrote entitled "A Field Study of Transponder Performance in General Aviation Aircraft," dated Dec 5, 1997. I found your report extremely interesting, especially your key finding (page vii) that nearly 1 in 5 transponders "...would create functionally significant problems when interacting with ground Secondary Surveillance Radar (SSR) processors, TCAS, or both." You elucidate that behavior when you describe the "Terra Problem" wherein "...a design characteristic of certain Terra transponders prevent them from responding consistently to...interrogations." During your study you were surprised to learn that some Narco AT150 transponders exhibited similar problems. You stated "Prior to this study, no reports have been published to suggest that the 'Terra like characteristic' had been observed in other transponder models."

THE PURPOSE OF THIS LETTER IS TO REPORT TO YOU THAT YET ANOTHER MAKE OF TRANSPONDER EXHIBITED THAT "TERRA LIKE CHARACTERISTIC." I documented this anomaly when I posted the following message on CompuServe's AViation Special Interest Group (AVSIG) forum...

Message: #852440, S/3 Air Traffic Control  
Date: Sat, Jul 15, 1995 1:11:18  
Subject: Xpdr problem @ 1 tracon  
From: Thomas Lusch/CMH 76545,2004  
To: ALL

Here's a baffling radar problem...

Around two or so weeks ago one of our club aircraft began to get bad transponder reports from ATC. Columbus Ohio (CMH) approach control would assign us a squawk, but they wouldn't "see" our transponder reply. Members began "squawking" <g> about the problem.

On Wednesday I took the "bad" transponder (a King KT-76) to Capital Aircraft Electronics at Port Columbus Airport. They let it run for several hours, running it hot and running it cold, and it "bench checked" with flying colors. They stated that the problem might be in the aircraft system. On Thursday I flew the aircraft over. Their test equipment showed it working just fine in the aircraft. They released it to me saying it was performing as per specifications.

Shortly thereafter I departed CMH and flew west for 25 or so miles. The transponder's reply light indicated it was replying to interrogations. However, not even once did any of my transponder replies show on CMH's radar! I was a primary target the \_entire\_ way.

>>>> Here's where it really gets interesting.... <<<<

Directly after terminating radar, I called Dayton (DAY) approach, asking for a transponder check. They assigned a code and my transponder replies showed up on their radar just fine. I immediately switched back to CMH to see if they were seeing my DAY assigned code, but I still only showed as a primary target!

After a fuel stop, I departed and flew midway between CMH & DAY. DAY saw my transponder replies just fine. CMH didn't. I then checked with Indianapolis Center, and they saw my CMH assigned squawk just fine! CMH didn't see my transponder replies at all that Thursday.

This is particularly hard for me to understand, as I happen to be a controller at CMH. Nearly three weeks ago our new ASR-9 was commissioned. From my vantage point behind the scope I am very impressed with how much better the ASR-9 is compared to the ASR-8 that we had been running. Our new radar has a much cleaner presentation. We see primary targets much more reliably, and the same goes for transponder targets. We can see aircraft much more reliably, at a greater distance, and at lower altitudes. (And the precip display is a quantum leap beyond the old ASR-8!)

As you may have ascertained, our club aircraft's transponder problem appears to be coincident with about the time CMH's ASR-9 was commissioned.

I took the aircraft over to CMH again on Friday. I spoke to the FAA radar techs about our problem, and they find it very strange. They hadn't received any other such problem reports. Capital Electronics ran their tests again, and everything appeared just fine. With a spare transponder in hand, myself and a Capital Electronics technician decided to fly it, and see if the problem was still there. We were prepared to swap out the transponder while in flight. As you might suspect, our "bad" transponder performed flawlessly.

We're all really baffled by this anomaly. If anybody out there might be able provide some guidance with this problem, we're all ears...

Tom

The only replies to the question I posed back in 1995 dealt with similar anecdotal problems...but no explanations. The radar technicians never did provide a plausible theory to this mystery. The FAA certified avionics shop was baffled too, especially since the transponder passed their repeated tests with flying colors. Then, some time later, the problem mysteriously went away. All indications pointed toward the newly running ASR-9 radar...but then something changed. It was sort of like the transponder magically got better. It didn't make sense. I now understand, having read your report, that modifications have been made to the Mode S ground radar interrogations (as described on page 18) to fix the "Terra problem." That is the most plausible explanation as to why these anomalies occurred.

I feel it is important to bring this to your (and the industry's) attention because it attests to the possibility of a more widespread problem in the fleet of GA transponders than may be realized or reported. This concerns me a great deal, as proper operation of transponders is the backbone of the ATC radar beacon & TCAS systems. It is disconcerting to realize that possibly 1 in 5 transponders, those that exhibit this "Terra like characteristic," are likely to be invisible to TCAS equipped aircraft!!!

The pieces of this puzzle all point to Mode S interrogations.

On an unrelated, yet extremely similar topic, I have enclosed a copy of my paper, "Real Targets - Unreal Displays..." as reprinted from the March '92 issue of the Journal of Air Traffic Control. That paper has nothing to do with transponders, or radar, or Mode S. It is purely a radar data processing problem...a result of ARTCC software not being able to handle the voluminous amount of excellent radar data available. However, it results in a similar condition...aircraft becoming invisible to the controller. Having visited Cleveland Center just last June, I observed that the problem still exists.

Sincerely,

Thomas G. Lusch

cc: FAA Administrator Jane Garvey, AOPA, ATCA, EAA, NASA-ASRS, NATCA, and others...

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