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# SERVICE INFORMATION LETTER

**Troubleshooting Guide for Airborne Weather Radar**

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**Transmittal Information**

Publication Number A23-2000-018

**Summary**

This revision is a FULL replacement. This revision includes the changes that follow:

- Changed the title from Troubleshooting Guide for PRIMUS 440, 650/870 and 660/880 Radar to Troubleshooting Guide for Airborne Weather Radar.
- Changed the effectivity statement and the applicable radar information.
- Changed the reason statement to reflect the service information letter is intended to help and advise customers with troubleshooting radars.
- Added the Honeywell Technical Publications website address and reference information.
- Changed the summary information.
- Changed the title from Troubleshooting Radar Performance Irregularities to Troubleshooting Radar Problems and changed or added troubleshooting information in Paragraph 1.E.(2).
- Changed the Action section information.

Because changes to this service information letter are sufficiently extensive, no revision bars have been used to identify individual changes to the document.

**Revision History**

This service information letter has had two revision(s) as shown in Table 1.

**Table 1. Revision History**

| Revision Number | Revision Date |
|---|---|
| Initial Release | 22 Feb 2008 |
| 1 | 24 Mar 2009 |
| 2 | 15 Feb 2012 |

## 1. General Information

### A. Effectivity

(1) The contents of this service information letter are equally applicable to all airborne weather radars, built by Honeywell or its competitors, however, it emphasizes Honeywell products, and the Honeywell PRIMUS 440, 660, and 880 radar in particular. Any parts that are only applicable to a limited product range are annotated as such.

### B. Reason

(1) Honeywell is often asked by customers for advice on troubleshooting radars. This document is intended to provide help and advise on the matter.

### C. References

(1) To find, see, and download Honeywell Technical Publications, go to www.myaerospace.com.

(2) The document(s) that follow(s) are suggested references applicable to this service information letter. Unless specified differently, you can use subsequent revisions.

- System Description and Installation Manual (SDOM), ATA Number 34-42-12 (Publication Number D199605000036), PRIMUS 880/660/440 Digital Weather Radar System, Revision 9
- PRIMUS 440 Digital Weather Radar System Pilot's Manual, Publication Number A28-1146-110, Revision 2
- PRIMUS 660 Digital Weather Radar System Pilot's Manual, Publication Number A28-1146-111, Revision 3
- PRIMUS 880 Digital Weather Radar System Pilot's Manual, Publication Number A28-1146-102, Revision 3
- Pilot's Manual, PRIMUS 880, 660, and 440 Weather Radar Systems for the Bendix/King EFIS 50 System Installations, Publication Number A28-1146-141-00, Revision 0
- Service Bulletin, ATA Number 7021450-34-9 (Publication Number A21-1999-147), WU-440/660/880 Receiver-Transmitter-Antenna - Product Software-Part No. 7021450-401, -411, -421, -601, -611, -621, -699, -801, -811, -821, -899; Honeywell Pub. No. A21-1999-147 - MOD G - Modification to Repair Error in Software, Revision 1.

### D. Summary

(1) None.

### E. Action

(1) **Contact Information**

(a) If, after troubleshooting an installation, the operator feels that more help is needed, contact:

Honeywell
Complete Customer Care Center
Telephone: (800) 601-3099 (U.S.A.)
Telephone: (602) 365-3099 (International)

(2) **Troubleshooting Radar Irregularities**

(a) Many modern weather radars have a fault code function, which will provide codes for many of the anticipated fault areas within the radar. However, there are many anomalies that either have no fault code, or are actually normal and consistent with known radar behavior. This service information letter attempts to discuss most of the more common anomalies.

(b) There are many misconceptions about weather radar, such as that it can see cloud, or that it can see dry hail. Both of these and many more are false. The various cases set out below will, hopefully, be of assistance to airplane crews and ground personnel.

(c) Radar Spoking – General

1 A very common complaint is spoking. This is an overused and misunderstood word, and hopefully, the following will clarify matters.

2 Most radars use an antenna which scans a circular area, some 300 nautical miles (NM) radius, in the horizontal (or azimuth) plane surrounding it. The scan is accomplished by mechanically rotating the antenna. Electronically steerable antennas, as used on many military aircraft, are not suitable for civil weather radar applications. As the antenna rotates, it gathers data on its surroundings in the form of radial lines of data. As a result, any transient undesirable signal or disturbance will tend to affect a small number of these radials. As a further result, when the data is processed for display on a plan position indicator, a radial line will be displayed corresponding to the affected radials.

3 This often looks like a spoke of a wheel and is called spoking.

4 Unfortunately, there are probably hundreds of ways to cause such disturbances, only some of which are caused by equipment malfunctions. This is poorly understood however, and we often get complaints of spoking from people who then get irritated when told that the term is nearly meaningless by itself because we cannot determine which of the hundreds is their particular problem.

5 A selection of specific types follows.

(d) Antenna Glitching

1 Refer to Figure 1.

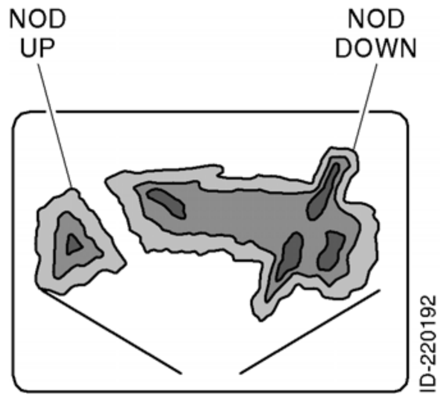



**Figure 1. (Sheet 1 of 1) Antenna Glitching**

2 The antenna on most weather radars is able to move in the elevation plane to accommodate stabilization and tilt commands. As the antenna is also scanning in the azimuth plane, the signals required to do this must be transferred to the moving part of the antenna. This is usually accomplished by means of a flexible cable but in some cases (now rare) it is done with slip rings. Thus, if breaks in the cable develop, it can cause the elevation axis to make small up or down jerks or glitches as it rotates. These glitches very often occur repetitively at the same azimuth angle.

3 This tends to be difficult to duplicate on the ground in the early stages as the high altitude coldsoak will make the wiring stiffer and shrink, thus aggravating the problem.

4 Depending on circumstances, the antenna may nod upwards and produce a radial gap in ground returns, or downwards and create a radial of extra ground returns.

5 The signature for this kind of spoking is as follows:

- Spokes are often at fixed azimuth positions.
- Spokes do not respond when the aircraft heading is changed.
- Bright spokes (nod down), are the result of increased ground returns.
- Dark spokes (nod up) are the result of an absence of ground returns.
- Weather and ground targets are normal except in the spokes.
- Spokes are not visible in display areas where no ground targets are available, such as extreme range.
- Usually highly intermittent in the early stages.

6 Corrective action: Remove and repair or replace the radar antenna or the receiver/transmitter antenna (RTA) unit.

(e) Interference

1 This is a normal radar phenomenon. It is an unfortunate fact that all X-band radars use the same frequency band (approximately 9,000

megahertz [MHz] to 9,600 MHz) and they tend to interfere with each other. It is a bit like being in a roomful of people who are all talking to each other. There are other frequency bands available, but the great consensus of opinion is that the current frequency choice is by far the best for airborne weather radars.

2 Refer to Figure 2, Figure 3, and Figure 4.

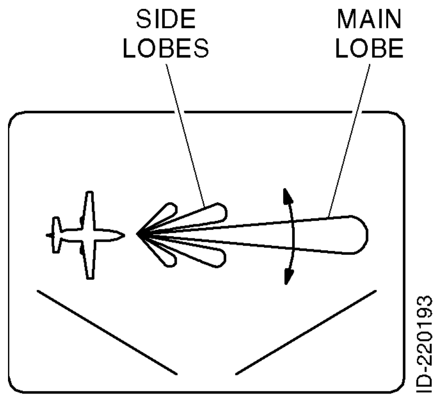



**Figure 2. (Sheet 1 of 1) Sidelobe**

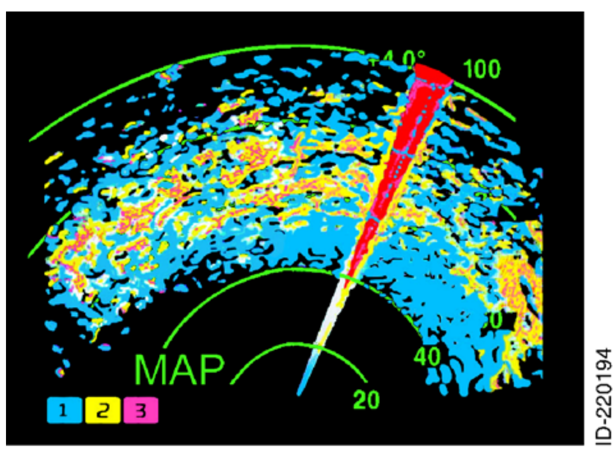



**Figure 3. (Sheet 1 of 1) Interference**

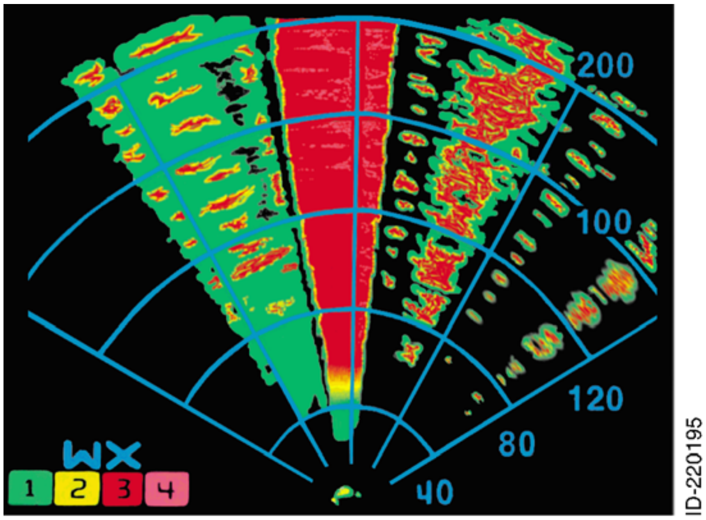



**Figure 4. (Sheet 1 of 1) Severe Interference**

3 Generally, interference sources can be broken down as follows:

- Other airborne radars
- Marine radars
- Military radars or jamming.

4 As the radar antenna scans past the source of the interference, interfering signals are picked up and processed for display. The processing in most radars is designed to ignore such signals as much as possible. However, when such signals penetrate the processing system, they will be displayed in the form of radial spokes. The radar antenna has the property of receiving mostly in one direction, but has some weak side lobes. (Refer to Figure 2) If the interference is strong enough, it will be received through the antenna sidelobes, and several spokes may be seen. This is complicated by the fact that if the source is a nearby rotating radar, the target illuminations of that radar may be seen. Thus a complex cluster of spokes may be seen in severe cases. (Refer to Figure 4)

5 The signature of such spoking is as follows:

- Spokes are usually at a constant radial on the screen.
- Spokes will respond to heading changes.
- Spokes will disappear at extreme tilt angles.
- Spokes will weaken or disappear at minimum variable (VAR) gain.
- Edges of spokes may be noisy, or soft.
- Spokes are strongest at long ranges due to sensitivity time control (STC) action.
- Spokes move slowly round the display as the aircraft moves in relation to the source.
- The radar picture is normal between the spokes.

6 Corrective action: none. This is a normal radar phenomenon.

(f) Rabbit Tracking

1 The term rabbit tracking was probably coined by some Women's Auxiliary Air Force radar operator in the Royal Air Force on a Type 7 metric search radar during World War II. This is a form of external interference that merits special discussion.

2 Refer to Figure 5.

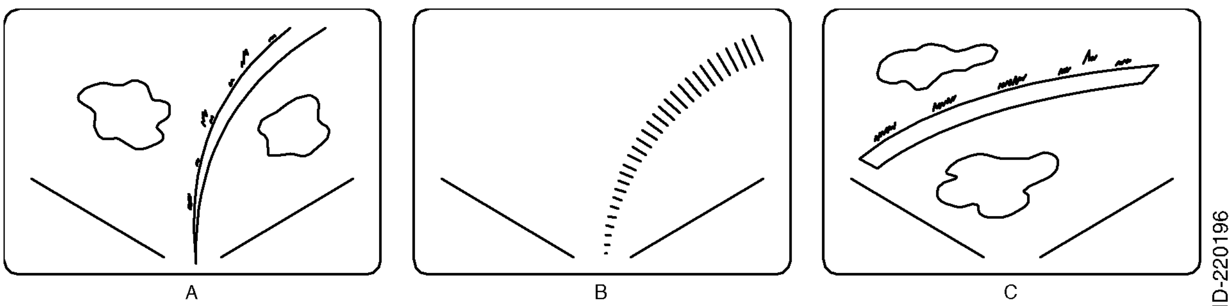



**Figure 5. (Sheet 1 of 1) Rabbit Tracking**

3 When the interference source is another (alien) radar, and when the pulse repetition frequency (PRF) is related to the radar being interfered with, curved lines will be seen.

4 Figure 5 illustrates several types of rabbit tracks:

- In the example in Figure 5A, the PRFs are fairly well separated and a near radial track is generated. Just behind the track, ground targets from the alien radar can be seen.
- In the example in Figure 5B, the alien radar is at a multiple of the PRF, resulting in this ladder pattern.
- In the example in Figure 5C, the two PRFs are very close to each other. Once again, alien ground returns are visible behind the interference. This type of track is more and more common as precisely controlled PRFs become commonplace.

5 The signature of this kind of spoking is as follows:

- Spokes may be curved.
- Spokes are strongest at long range.
- Spokes may disappear on some ranges due to PRF changes.
- Radar picture is normal between spokes.
- Spokes weaken or disappear at minimum VAR gain.
- Spokes are at random positions on the screen.

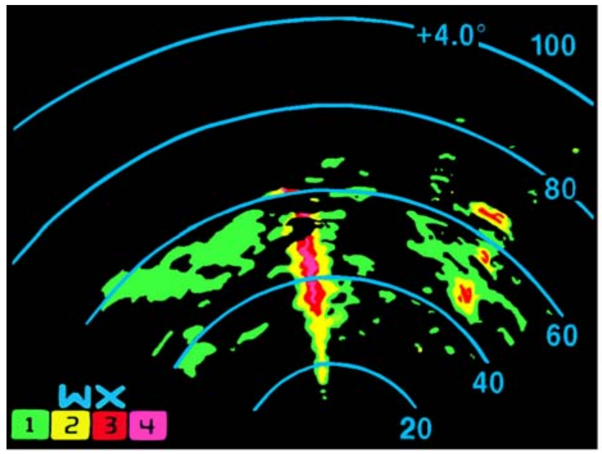
6 Corrective action: none. This is a normal radar phenomenon.

(g) Rain Echo Attenuation Compensation Technique (REACT) Pumping

1 Radars which use a REACT, can exhibit a peculiar type of spoking when REACT compensation is active. Small strong ground targets can be viewed by the radar as attenuating targets, even though they

are small. This will cause the REACT to increase signal level behind the ground target and form a spoke.

2 Refer to Figure 6.




ID-220197

**Figure 6. (Sheet 1 of 1) REACT Pumping**

3 The signature of this kind of spoking is as follows:

- Fairly transient - usually only lasts a minute or so.
- Deselecting REACT will eliminate.
- Spokes only present where targets are displayed.
- Tilt change will eliminate.

4 Corrective action: none. This is a normal radar phenomenon.

(h) Antenna Jitter (P-880 only)

1 Honeywell has verified that some rejections for spoking have been caused by an occasional slight jitter in the antenna elevation. It appears that the cause is related to hysteresis in the processing of the elevation feedback and stabilization input signals and that they occasionally can work against each other, causing a jitter in elevation. Software MOD G given in Service Bulletin, ATA Number 7021450-34-9 (Publication Number A21-1999-147), will significantly reduce this phenomenon.

2 The signature for this condition is:

- Long ranges with the tilt adjusted to show a very light green ground return, for example: 50 percent to 70 percent coverage. When the jitter happens, you may see an area in the ground returns where there are adjacent thin, darker, and lighter radials
- This display typically will be shown for only a fraction of the sweep angle

- Will usually will be present for 15 seconds to 1 minute, then goes away, but may come back later in the same or a different area
- A slight adjustment of the tilt control up or down will make this indication stop.

NOTE: If any or all of these conditions are observed, it is not a reason to reject the radar.

3 Corrective action: none or install software MOD G (Service Bulletin, ATA Number 7021450-34-9 [Publication Number A21-1999-147]).

4 There are many other anomalies that deserve a mention, some of which are described below.

5 Automatic Frequency Control (AFC) Unlock:

a Most magnetron based weather radars employ an AFC system that ensures that the receiver frequency tracks the transmitter frequency. If the transmitter becomes weak or unstable, the AFC may go into its search mode and start searching the Xband spectrum for the transmitter. This will cause noisy spokes to appear in the display.

b The signature of this condition is:

- Spokes are at different locations on the display all the time.
- No weather or ground returns are seen.
- Spokes occur at a constant time cadence.
- Tilt has no effect.
- Gain may have some effect.
- May stop on longer ranges due to the transmitter pulse being wider.
- May be due to waveguide arcover at high altitudes.

6 Corrective Action:

a Verify that waveguide pressure supply is intact and not blocked.

b Remove and replace the receiver/transmitter (RT) or the RTA unit.

(i) Antenna Position Indicator (API) Indications (P-880 only)

1 Some of the more recent Honeywell radars have the ability to display an API in the form of a curved white (yellow or orange on some installations) line at the outer edge of the display. This line grows and shrinks so that its left hand end is stationary at the left outer corner of the display. At the same time, the right hand end is at the current antenna position as the antenna sweeps back and forth. This function can be enabled or disabled by grounding a pin on the main connector of the radar RT or RTA unit.

2 This has been misunderstood and has been the cause of equipment removals.

3 Corrective action: none, or ground the API disable pin on the RT/RTA. See the appropriate System Description and Installation Manual.

(j) Radome Irregularity

1 Radome design deficiencies, damage, inappropriate paint, water ingress, all contribute to degradation of the radar performance. Each of these has its own symptoms and corrective action.

2 Water in laminations:

a Most radomes are either a fluted or honeycomb matrix covered with two thin layers of epoxy/fiberglass to keep the water out. If the outer skin gets damaged, the slipstream of the airplane will soon force rainwater into the inner layers. Once water has penetrated to one of the honeycomb cells, it will freeze the next time the airplane flies above the freezing level. This will break down the walls into the neighboring cells. Thus, the radome rapidly becomes waterlogged. Chemicals from the fiberglass and epoxy materials dissolve into the water, making it conductive, and largely radar opaque.

b The effects from these areas will change depending on if the water is frozen or liquid. If liquid, the effect will tend to be worse. The trapped water can cause weak returns, dead areas in the returns, or altitude circles spots. These can be easily identified because they will not move with aircraft heading change. When frozen, the effect will not be as bad, but the performance of the radome will still be degraded. Because the water is trapped, the effects will be more or less constant. Cracks or scrapes in the paint generally will not cause this type of problem, unless they are deep enough to compromise the fiberglass layers.

NOTE: If the radome has been treated with an antistatic primer, moisture meter readings for the entire radome may be somewhat degraded. Nevertheless, areas of water intrusion will stand out from moisture free areas.

c Corrective action: a radome moisture meter can be used to test a radome for water ingress. Repair or replace the damaged radome. Such a repair task is beyond the capacity of regular fiberglass repair businesses, and should only be undertaken by experts. We have seen cases where damage has been repaired with ordinary automotive panel beaters putty.

d Refer to http://www.aquameasure.com/radome.htm for a typical moisture meter.

NOTE: Honeywell does not recommend any particular unit or manufacturer. This information is offered purely in the spirit of customer information.

3 Inappropriate paint:

a The paint used on radomes is crucial. Many paint manufacturers have no idea how their paint performs on a radome, and the inability to answer questions is a sure indicator that they are disqualified. The wrong paint can turn a radar transparent radome into the equivalent of a sheet metal nose cone.

4 Radome for the wrong frequency:

a A radome is designed for a specific frequency, and if a radome for the wrong frequency band is used, very large standing waves will be set up. This can cause AFC unlocks, strong fixed targets, and weak radar performance. Currently there are three frequency bands approved for airborne weather radars:

- C-band (5,500 MHz), very bulky equipment.
- X-band (9,300 MHz), good compromise. Used by all current radars (2011).
- Ku-band (14’000 MHz), very little weather penetration ability, hard to maintain.

b The radome must be designed for the frequency in use.

c Corrective action: verify that the radome is built for the correct frequency, replace it if not.

NOTE: On small aircraft, there is no danger that a radome might be a C-band radome because C-band antennas are huge. However, an old aircraft might have a Ku-band radome. The Bendix RDR100 was Ku band and went out of production about 1971. An old B727 might well have a C-band radome as United Airlines used C-band exclusively until about 1985.

5 Design issues:

a The best shape for a radome is hemispherical and about the best radome on any large aircraft is on the DC9 (Boeing 717). Any deviation from this is going to degrade the radome at least slightly. Unfortunately, hemispherical radomes are unsightly, and have poor aerodynamics. One of the worst radomes in commercial aviation was on the Concorde. It suffered extreme loss dead ahead where there was a very thick area made to withstand Mach 2.2 airflow. To make things worse, it had a metal pitot tube on the tip with plumbing and wiring going to it.

(k) Dents and Scratches in Antenna Plate

1 Flatplate antennas are remarkably robust but they can be damaged. Serious dents that are more than 0.5 inch (12.7 mm) from the periphery should be regarded with suspicion. The symptom, as reported by aircrew, may be that they see an altitude ring that they did not see before.

2 Scratches on flatplates have little impact so long as the metal sheet of the front or back is not distorted. They will however, compromise the surface passivation and should be treated to prevent corrosion. Use a simple zincchromate etching primer.

(l) Stabilization Issues

1 The stabilization system takes pitch and roll information from the vertical reference system of the airplane and by means of servos, moves the antenna up or down to keep it pointing at the same tilt angle as it scans. The usual stabilization squawk is that ground returns are seen during pitch or roll excursions.

2 It should be noted that most weather radars have a maximum elevation angle of 30 degrees to accommodate combined pitch, roll, and tilt angles. The appearance of ground returns while practicing 45 degree steep turns is not a reason to snag the radar.

3 Corrective action: Refer to the appropriate System Description and Installation Manual for instructions for adjusting the pitch and roll stabilization servo gains.

(m) Altitude Rings or Arc Phenomenon

1 Altitude rings are a feature of all radars. If the radome is perfect and the flat plate antenna in good condition (not bent), they should be so weak as to be invisible. Altitude rings are caused when energy reflects off the inside of the radome and forms a sidelobe that points directly downwards. The exact path is often complex, involving reflections of various metal objects inside the radome. However, the first suspect is always the radome.

2 The errant energy reflected by the radome travels down the ground, then is reflected back to the radar by way of the same path. Thus, the distance to the displayed altitude ring is closely related to the altitude of the aircraft. For example, an aircraft flying at 30,000 feet above ground level (AGL) might show an altitude ring at 5 NM. For this reason it is known as an altitude ring.

3 In the past, when we had parabolic dishes, altitude rings were considered a sign that the radar was working correctly. If a pilot didn't see one he would snag it. However, flatplate radiators have much weaker sidelobes, and don't suffer the problem often. Unfortunately,

no radome is perfect so an altitude ring is not a cause for concern, unless it suddenly appears or gets stronger on a specific aircraft.

4 If an altitude ring suddenly appears or gets stronger on a specific aircraft, the user should suspect water ingress into the radome laminations through pinholes in the outer skin. It is possibly due to a small lightning strike. Remember, aircraft get hit by lightning when parked on the ground.

5 In the display shown in Figure 7, taken aboard an airplane flying at about 40,000 feet AGL. A narrow ring is seen at about 7 NM. This is a typical altitude ring. However, altitude rings can also be bean shaped targets at each side of the aircraft, or a complete circle from one side to the other. It will be noted that the range to the ring very closely relates to the airplane altitude in miles. An altitude ring that is not symmetrical about the fore and aft axis is a cause for concern as it indicates that something (probably the radome) is asymmetrical.


**Figure 7. (Sheet 1 of 1) Altitude Rings or Arc Phenomenon**

6 Corrective action:

a Altitude rings do not indicate a radar malfunction, unless the flat plate radiator is damaged. They are caused by reflections off the inner surface of the radome, which in a well designed radome are minimal.

b Inspect the radome for signs of water in the laminations or physical damage. Use a radome moisture meter. See the section on radomes that begins in Paragraph 1.E.(2)(j).

(n) Waveguide Problems

1 Radars with separate RT and antenna units use a waveguide to transport radio frequency (RF) energy to and from the antenna. This is a square metal tube (can be oval or round.) with 0.5 inch (12.7 mm) or 1 inch (25.4mm) dimensions.

2 Waveguides are normally reasonably robust, but as they transport complex electric and magnetic fields, cracks, breaks, or corrosion can have serious consequences. We have seen cases where a waveguide was at a convenient location to be a useful handhold, and was cracked along one of the corners. In this case, it had been repaired with duct tape.

3 The signature of such damage is highly variable, but look out for:

- Weak radar returns
- AFC unlock
- Malfunctions at high altitude.

4 In one notable case, the waveguide in a King Air was full of water. The radar worked somewhat at high altitude but was effectively dead at low altitude because the water froze and became fairly transparent at low temperature. At lower altitudes the water melted and became opaque.

NOTE: The waveguide in a King Air runs under the air conditioner, thus forming a U tube.

(o) Attenuation

1 A problem with any radar is that it transmits energy and then detects returns from distant objects such as terrain or weather. However, if something gets in the way of these outgoing or incoming signals, the radar sensitivity will be reduced or eliminated. Thus, if there is a rain filled weather target between the radar and another target, the signals from the second target will be weakened.

2 A fairly common occurrence is when an aircraft is flying in steady but nonturbulent rain. The pilot may see a large block of green/yellow targets that stretch perhaps 5 or 10 miles ahead of the aircraft. The pilot then assumes that after that distance they will be in the clear, or conversely, that pilot may assume the radar is defective. Neither is true.

3 What is happening is that after travelling 5 or 10 miles through the rain and back to the radar, there is little if any energy left due to the losses caused by the rain. This was the cause of the Air Wisconsin Flight 965 accident on 12 June 1980. The crew saw about 11 miles of solid, fairly low level targets ahead of the aircraft and kept wondering why it did not end. One of the surviving persons on board watched the sequence on the radar (an RCA AVQ47) and saw the black contour hole of the thunderstorm appear at about 9 miles.

4 The Honeywell REACT system detects this condition and adds a cyan field in areas where the radar is blinded by attenuation. Refer to Figure 8

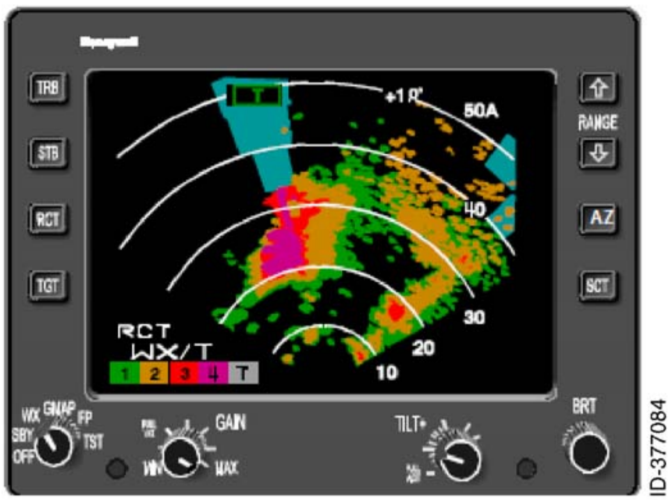



**Figure 8. (Sheet 1 of 1) Areas of Attenuation in Cyan, Honeywell REACT System**

5 Corrective action: none or educate aircrew. This is a normal radar behavior.

(3) **Troubleshooting With TEST Mode Fault Annunciations**

(a) Critical functions in both the P-650/870 and P-660/880 RTAs are continuously monitored. For each weather radar system, troubleshooting information is provided for each monitored fault condition, as shown in Table 2:

**Table 2. Troubleshooting Information**

| P-650/870 Troubleshooting Information | P-660/880 Troubleshooting Information |
|---|---|
| Fault codes: 1 or 2-digit fault codes, shown one at a time, in place of the radar tilt angle. | Text faults: English text fault information, displayed in the radar test pattern areas, with fault name, a pilot message, a fault code, and a line maintenance message for each fault condition. |

(b) When a fault occurs for a monitored function (either in-flight or on-ground), an amber FAIL will replace the weather radar mode annunciation on the electronic flight information system (EFIS) displays. The annunciation will remain until the fault condition clears. To clear the fault, the crew should follow the corrective action as described in Table 3 (for P-650/870) or Table 4 (P-870 with MOD R installed) or Table 5 (P-660/880).

(c) P-650/870 (pre MOD R): once in TEST, if a failure is detected the TEST annunciator will be replaced by an amber FAIL annunciator and amber fault codes will be displayed in the area usually used to display digital tilt data. Check Table 4 for suggested corrective action.

NOTE: The fault code column has been divided in two. The left side is for P-650 and the right for P-870.

NOTE: Some PRIMUS650 installations may display some other number in the leading zero position of the EFIS fault code. This should be ignored if seen.

**Table 3. P-650/870 (pre MOD R) Troubleshooting With Fault Codes**

| Fault Code 650 | 870 | Fault Description | Corrective Action |
|---|---|---|---|
| 01 | 21 | Azimuth scanning incorrectly | Confirm SCAN switch ON. Confirm nothing obstructing RTA scan. Remove and replace RTA and note fault code on repair tag. |
| | 31 | Antenna elevation error | Remove and replace RTA and note fault code on repair tag. |
| | 03 | Analog-to-digital converter failure | Confirm stabilization source is in the proper mode. Check ARINC 429 continuity between stabilization source and RTA. Check ARINC 429 isolation to shield. Check ARINC 429 isolation ground. If no problem found, remove and replace RTA and note fault code on repair tag. |
| 02 | 22 | Stab reference | Confirm stabilization source is in the proper mode. Check ARINC 429 continuity between stabilization source and RTA. Check ARINC 429 isolation to shield. Check ARINC 429 isolation ground. If no problem found, remove and replace RTA and note fault code on repair tag. |
| | 32 | NAV high speed ARINC 429 failure | Confirm high speed ARINC 429 source is in the proper mode. Check ARINC 429 continuity between high speed ARINC 429 source and RTA. Check ARINC 429 isolation to shield. Check ARINC 429 isolation ground. If no problem found, remove and replace RTA and note fault code on repair tag. |
| | 13 | +15 volt (V) failure | Remove and replace RTA and note fault code on repair tag. |

**Table 3. P-650/870 (pre MOD R) Troubleshooting With Fault Codes (Cont)**

| Fault Code 650 | 870 | Fault Description | Corrective Action |
|---|---|---|---|
| 03 | 23 | Automatic gain control failure | Remove and replace RTA and note fault code on repair tag. |
| | 33 | -15V failure | Remove and replace RTA and note fault code on repair tag. |
| | 16 | Magnetron voltage failure | Remove and replace RTA and note fault code on repair tag. |
| 04 | 24 | Mixer current failure | Remove and replace RTA and note fault code on repair tag. |
| 05 | 25 | AFC lock failure | Remove and replace RTA and note fault code on repair tag. |
| 05 | 35 | AFC sweep failure | Remove and replace RTA and note fault code on repair tag. |
| 06 | 26 | Fan voltage abnormal | Remove and replace RTA and note fault code on repair tag. |
| | 04 | DADC low speed ARINC 429 failure | Confirm DADC low speed ARINC 429 source operational. Check ARINC 429 continuity between Low Speed ARINC 429 source and RTA. Check ARINC 429 isolation to shield. Check ARINC 429 isolation to ground. If no problem found above, remove and replace RTA and note fault code on repair tag. |
| | 06 | Airspeed (DADC or analog) | Confirm Airspeed source operational. Check ARINC 429 continuity between Airspeed source and RTA. Check ARINC 429 isolation to shield. Check ARINC 429 isolation to ground. If no problem found above, remove and replace RTA and note fault code on repair tag. |

**Table 3. P-650/870 (pre MOD R) Troubleshooting With Fault Codes (Cont)**

| Fault Code 650 | 870 | Fault Description | Corrective Action |
|---|---|---|---|
| 07 | 07 | Pulse pair processor failure | Remove and replace RTA and note fault code on repair tag. |
| | 27 | VLSI failure-loss of video ready interrupt | Remove and replace RTA and note fault code on repair tag. |
| | 30 | Non-volatile memory failure | Remove and replace RTA and note fault code on repair tag. |
| | 37 | Ram test failure | Remove and replace RTA and note fault code on repair tag. |
| | 14 | Parallel altitude change | Confirm Airspeed source operational. Check ARINC 429 continuity between airspeed source and RTA. Check ARINC 429 isolation to shield. Check ARINC 429 isolation to ground. If no problem found above, remove and replace RTA and note fault code on repair tag. |
| | 36 | Altitude failure | Confirm altitude source operational. Check ARINC 429 continuity between altitude source and RTA. Check ARINC 429 isolation to shield. Check ARINC 429 isolation to ground. If no problem found above, remove and replace RTA and note fault code on repair tag. |

**Table 4. P-870 (MOD R) Troubleshooting With Fault Codes**

| Fault Code 870 | Fault Description | Corrective Action |
|---|---|---|
| 21 | Azimuth scanning incorrectly | Confirm SCAN switch ON. Confirm nothing obstructing RTA scan. Remove and replace RTA and note fault code on repair tag. |
| 31 | Antenna elevation error | Remove and replace RTA and note fault code on repair tag. |
| 03 | Analog-to-digital converter failure | Confirm stabilization source is in the proper mode. Check ARINC 429 continuity between stabilization source and RTA. Check ARINC 429 isolation to shield. Check ARINC 429 isolation ground. If no problem found, remove and replace RTA and note fault code on repair tag. |
| 22 | STAB reference | Confirm stabilization source is in the proper mode. Check ARINC 429 continuity between stabilization source and RTA. Check ARINC 429 isolation to shield. Check ARINC 429 isolation ground. If no problem found, remove and replace RTA and note fault code on repair tag. |
| 23 | Automatic gain control failure | Remove and replace RTA and note fault code on repair tag. |
| 16 | Magnetron voltage failure | Remove and replace RTA and note fault code on repair tag. |

**Table 4. P-870 (MOD R) Troubleshooting With Fault Codes (Cont)**

| Fault Code 870 | Fault Description | Corrective Action |
|---|---|---|
| 24 | Mixer current failure | Remove and replace RTA and note fault code on repair tag. |
| 25 | AFC lock failure | Remove and replace RTA and note fault code on repair tag. |
| 30 | DSP hold failure | Remove and replace RTA and note fault code on repair tag. |
| 37 | Ram test failure | Remove and replace RTA and note fault code on repair tag. |

**Table 5. P-660/880 Troubleshooting With Fault Codes**

| Fault Code | Pilot Message | Fault Description | Corrective Action |
|---|---|---|---|
| 01 | RADAR FAIL | Radar is currently inoperable and should not be relied upon. | Remove and replace RTA and note fault code on repair tag. |
| 02 | RADAR FAIL | Radar is currently inoperable and should not be relied upon. | Remove and replace RTA and note fault code on repair tag. |
| 03 | RADAR FAIL | Radar is currently inoperable and should not be relied upon. | Remove and replace RTA and note fault code on repair tag. |
| 03 | REDO STAB TRIM | Stored stab trim data has been corrupted. | Adjust stab trim, if necessary. |
| 04 | RADAR FAIL | Radar is currently inoperable and should not be relied upon. | Remove and replace RTA and note fault code on repair tag. |
| 05 | RADAR FAIL | Radar is currently inoperable and should not be relied upon. | Remove and replace RTA and note fault code on repair tag. |
| 06 | RADAR FAIL | Radar is currently inoperable and should not be relied upon. | Remove and replace RTA and note fault code on repair tag. |
| 07 | RADAR FAIL | Radar is currently inoperable and should not be relied upon. | Remove and replace RTA and note fault code on repair tag. |
| 10 | RADAR FAIL | Radar is currently inoperable and should not be relied upon. | Remove and replace RTA and note fault code on repair tag. |
| 11 | RADAR FAIL | Radar is currently inoperable and should not be relied upon. | Remove and replace RTA and note fault code on repair tag. |
| 13 | TILT UNCAL | An error in antenna position system has been detected. Displayed tilt angle setting could be incorrect. May also cause ground spoking. | Check to make sure radome is fitted properly and that radar antenna clears radome in all orientations. Ensure antenna scans in azimuth direction and moves to commanded elevation position. |
| 14 | TILT UNCAL | An error in antenna position system has been detected. Displayed azimuth angle setting could be incorrect. May also cause ground spoking. | Check to make sure radome is fitted properly and that radar antenna clears radome in all orientations. Ensure antenna scans in azimuth direction and moves to commanded elevation position. |

Table 5. P-660/880 Troubleshooting With Fault Codes (Cont)

| Fault Code | Pilot Message | Fault Description | Corrective Action |
|---|---|---|---|
| 15 | RADAR CAUTION | A failure has been detected that may compromise the calibration accuracy of the radar. Information from the radar should be used only for advisory purposes such as ground mapping for navigation. | Remove and replace RTA and note fault code on repair tag. |
| 16 | RADAR UNCAL | Radar power has dropped below prescribed limit or invalid configuration strapping. | If strapping confirmed OK, remove and replace RTA and note fault code on repair tag. |
| 20 | CHK CNTL SRC | Control source (WC-660 or WC-880) not communicating with RTA. | Check control source and aircraft wiring at next opportunity. |
| 21 | PICTURE UNCAL | Radar functions are OK, but receiver calibration is possibly degraded. Color level calibration should be assumed to be incorrect. | Remove and replace RTA and note fault code on repair tag. |
| 21 | RADAR FAIL | Radar is currently inoperable and should not be relied upon. | Remove and replace RTA and note fault code on repair tag. |
| 22 | PICTURE UNCAL | Radar functions are OK, but receiver calibration is possibly degraded. Color level calibration should be assumed to be incorrect. | Remove and replace RTA and note fault code on repair tag. |
| 24 | SPOKING LIKELY | A problem has been detected (multiple AFC unlocks) which may cause spoking to occur. | Remove and replace RTA and note fault code on repair tag. |
| 24 | RADAR FAIL | Radar is currently inoperable and should not be relied upon. | Remove and replace RTA and note fault code on repair tag. |
| 27 | STAB UNCAL | An error in antenna positioning system has been detected. Ground spoking, or excessive ground returns during roll maneuvers may occur. This may be due either to the RTA or the source of pitch and roll information to the RTA. | Check stabilization sources and/or aircraft wiring. |

Table 5. P-660/880 Troubleshooting With Fault Codes (Cont)

| Fault Code | Pilot Message | Fault Description | Corrective Action |
|---|---|---|---|
| 30 | TURB UNCAL (880 radar only) | Either airspeed/ ground speed has become unavailable or a problem has been detected with turbulence detection hardware. Assume turbulence display to be inaccurate. Non-turbulence modes should be functioning properly. | Check ARINC 429 isolation to shield. Check ARINC 429 isolation to ground. If no problem found above, remove and replace RTA and note fault code on repair tag. |
| 33 (P-880 only) | NO ACT | No altitude information is available to make altitude compensated tilt calculation. Otherwise, unit may be operated as normal. Have system (including altitude source) checked at the next opportunity. | Check ARINC 429 isolation to shield. Check ARINC 429 isolation to ground. If no problem found above, remove and replace RTA and note fault code on repair tag. |
| 34 | SCAN SWITCH | SCAN SWITCH located on RTA is off, disabling antenna scan. | Check at next opportunity to ensure switch is ON and that antenna scans in azimuth when in an operational mode. |
| 35 | XMIT SWITCH | XMIT SWITCH located on RTA is off, disabling transmitter. | Check at next opportunity to ensure switch is ON. |
| 36 | RADAR UNCAL | Invalid altitude/airspeed/stab strapping | Check all configuration straps and/or aircraft wiring. |
| 36 | RADAR FAIL | Radar is currently inoperable and should not be relied upon. | Remove and replace RTA and note fault code on repair tag. |

(d) Select the appropriate fault code from Table 5 and perform the associated steps.

(e) P660/880: upon entering the TEST mode, if there are no currently active faults, a RADAR OK message will be displayed for one sweep. After that the most recent fault code is displayed, cycling to the oldest fault in the eligible list of faults. Upon reaching the last fault an END OF LIST message will be displayed. To re-cycle through the list again, exit and re-enter the TEST mode. Ensure power on count = 0 for the faults associated with the current power on cycle. Check Table 5 for suggested corrective action.