Anomalous Echoes Captured by a B-52 Airborne Radarscope Camera: A Preliminary Report

(Part 1)

Martin Shough (*Note 1, see end of Part 2*)

1. Abstract

Radarscope photographs of unidentified radar indications were taken aboard a USAF B-52H flying NW of Minot AFB, North Dakota, on Oct 24 1968. The scope photos are first briefly described, followed by the radar equipment specifications. Some issues arising in the reconstruction of times and distances are then addressed, and finally some avenues of interpretation are explored in the light of the equipment specifications, flight data and radar propagation issues.

Explanations are attempted (see *Section 6*) in terms of aircraft and missiles, meteors, precipitation, moon returns, lightning (including lighting channel echoes, sferics and ball lightning), auroral ionisation, birds, insects, satellites, RFI, internal noise, ECM spoofing and anomalous propagation. No convincing explanation of the unidentified echoes is found.

The Air Force file contains discussion of a "pretty good" temperature inversion between 2000-5000ft and speculates that this may have been the cause of an "anomalous blip". However, since the radar refractive index (RI) is about five times more sensitive to changes in humidity than to changes in temperature, this is not very meaningful. In fact a correct *N*-unit profile of the refractivity gradient constructed (*Section 6.k*) from temperature and dewpoint data found in the Air Force file indicates no elevated RI anomalies. But the file data - lacking original date-time information and from a remote rawinsonde station - were found to be of doubtful relevance and even of doubtful provenance.

Reliable and more complete archival data were obtained from the US National Climatic Data Center for the nearest balloon releases bracketing the period of observation. These soundings indicate gradients generally quite close to the mean up to the highest readings at 500 mbar, with weak elevated *sub*refractive layers developing below the B-52 flight level. These features are only marginally (<5 *N*-units / kft) outside the nominal limits of "standard" refractivity and do not indicate any obvious cause of strong unexplained echoes on the airborne radar.

Hoever these are average gradients. It remains possible that undetected narrow layers of sharp RI gradient might fall between the samples, or that higher level tropopausal structures might exist off the top of the diagram. But both the echo presentation and its persistence at a constant azimuth during a significant period of straight flight seem

impossible to explain as direct backscatter from even a highly efficient hypothetical layer, and the displayed range combined with strongly interlocking evidence of the B-52 altitude rules out a 1st-trip ground echo by any ray path.

A possible interpretation of a part of the photo sequence is offered in terms of 2nd-trip echoes from a terrain feature beyond the unambiguous range of the radar, combined with ghost echoes due to signals received *via* a dual ray path in unusual (hypothetical) atmospheric conditions. However, the one attractive candidate for such a topographical target is shown to be a minimum of about 30 degrees away from the true echo azimuth at any point on the flight track during the incident. The possibility of a large error in the recorded flight track, which would bring the position of the aircraft into coincidence with this theory, is shown to be inconsistent with radar-photographic evidence of the B-52's descent rate. Finally the official documentary and aircrew evidence in regard to the persistence of the radar contact at a constant bearing over a ground track of some 25 miles (in the order of 10 times the duration of the extant photo record) appears to be inconsistent with this hypothesis.

A very unusual type of interference from a very similar airborne pulse radar set at long range is considered theoretically possible, but the extremely strict conditions required render the theory very strained indeed. Several other theories are considered and rejected, generally on quite basic quantitative grounds, as either impossible or very unlikely.

In summary, although the available hard radar evidence cannot in itself constitute proof of the presence of one or more extraordinary airborne objects, it is concluded that explanations of the echoes so far considered are unconvincing. In general the probability of a highly unusual radar anomaly has to be estimated in the context of surrounding air/ground visual reports and other events detailed elsewhere by the principal investigators.

This study is based on digital scans of fourteen 8 x 10 photographic prints, Blue Book file information, interview transcripts and technical and background data supplied by principle investigators Tom Tulien and Jim Klotz. This material is supplemented by additional technical specifications obtained by the author, independent measurements of the photos by Brad Sparks and Dr. Richard Haines, and further consultation with witnesses, investigators and others. Detailed discussions with Dr.Claude Poher were helpful in improving an earlier draft of this report, leading to revision of some estimates of echo displacement in *Section 5.iii*. The author also acknowledges the help of former B-52 radar-navigator Richard Sessler; a USAF M/Sgt and former B-52 bomb-nav radar technician who wishes not to be named but who contributed invaluable advice and documents; and Ed Doyle of Radio Research Inc., Waterbury, Connecticut.

2. General Description of Radarscope Photographs

All 14 photographs show the illuminated bearing ring and tube face of a 10-inch diameter circular Plan Position Indicator (PPI). There is a consecutive numbered sequence of 13 frames showing the radarscope in a 360-degree surveillance mode called Station Keep, and a 14th frame showing the same scope in an unidentified sector scan mode.

i.) the 13 numbered frames

A marker strobe on the PPI paints from the centre-spot out to the bearing ring and indicates the aircraft heading. In all cases the aircraft heading marker is on the same azimuth, 122 degrees. (A secondary marker appears in each photo, displaced clockwise from the heading marker by the same angle. This is understood to be a variable azimuth marker normally used together with a variable range marker - not appearing on scope in the radar mode selected - as a cross-hair for bomb targeting and navigation purposes. The position of this strobe is not believed to be significant.)

A numbering meter and an analogue clock shown on 13 of the photographs, numbered 771 to 783, prove that they are an unbroken sequence. A handwritten data plate carries the words "Bismarck" and "St.George" (locations in North Dakota and Utah respectively, relating to the flight plan) along with the date, aircraft identification, names of operators (Richey and McCaslin) and radar system AN designation "ASQ 38", proving that the photos relate to the case in question.

The update rate is 3 seconds, approximately synchronised with the 3 second scan rate of the radar. (There is evidence of a possible discrepancy of about 2% which by frame 783 accumulates to between 1/2 and 1 second.) The camera objective lens is integral to the CRT and the PPI image is routed to an externally-mounted camera by a system of prisms. Each photo is a time exposure of one rotation of the PPI trace with a 50 millisecond interval for film advance between frames. The clock, data plate and numbering meter are double-exposed onto the film *via* a separate optical pathway.

The radar (rotating antenna mounted beneath the nose of the B-52H) is an essentially downward-pointing bombing-navigation radar that scans the ground and air in various modes. Consequently the PPI shows a dark central region, known as the "altitude hole", surrounded by an annulus of fairly uniform bright echo which is ground return. Certain details inside this bright area appear to be topographical features. The altitude hole extends to approximately 1/3 of the PPI radius and is almost the same diameter on all photos, reducing in size only slightly in relation to the range rings over the series of 13 scans.

Concentric bright range rings are visible inside the altitude hole, having a spacing of one half-mile (nautical) corresponding to a maximum display range of approximately 5 NM. No range-scale indicator is shown however, and the range representation is slightly non-linear owing to a short-range TR (transmit/receive) "hole" in the middle of the display (*Note 2*).

Most of the photographs also show rather discrete echoes of varying brightness inside the altitude hole at varying azimuths, apparently indicating a target or targets in the air near the B-52 at slant ranges of a mile or two. These unidentified echoes and their characteristics will be described in detail presently.

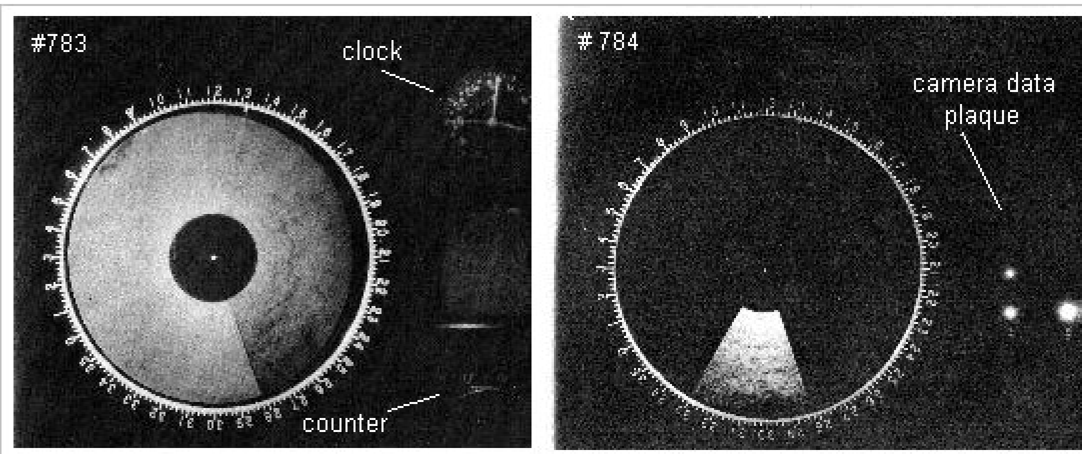
These 13 photographs also all show a bright smudge to the left of the centre-spot which has been tentatively identified (by Dr. Richard Haines) as a ghost image of the bright centre-spot itself, doubly reflected from the camera lens onto the tube face and thence back into the camera. (However see also *Note 2*)

The photos vary somewhat in contrast and resolution. The distinctness of the heading marker and range rings tends to decrease through the series 771-782, whilst speckles of noise around the periphery of the altitude-hole tend to increase in density. On frame 783 these heading and range markers appear more distinct again, the speckling has disappeared and some fugitive ground features seem to become more visible. The markers are generated electronically by a circuit that brightens the scope trace, and some of these changes may be caused by manual adjustments to the video amplifier gain.

Frames 772-783 all record full 360-degree scans, each showing a set of complete range rings, whilst 771 captures approximately half of one 360-degree scan, showing *semi*-circular range rings where only half of the scope has been written on. Frame 771 appears to show the camera being switched on in mid scan (see *Section 5.iii*).

ii) the 14th frame

The remaining 14th photo differs, showing a 48-degree sector-scan of terrain, dense with ground return. The azimuth-marker tick on the bearing ring appears to be in the same position in this frame, and the display orientation appears to be identical (approximately a heading-up presentation as photographed, with 120 degrees at the top of the picture), but neither the clock nor the counter nor the data plate are visible to the right of the PPI. In place of these are three illuminated lamps, indicating that the radar is switched into a different mode with a different range scale (see *Section 4*).



360° PPI scan in Station Keep mode showing clock and frame counter with hand-written data plate between. Range scale 5 NM

Sector scan, not available in Station Keep. Clock and counter are replaced by a 'plaque' of lamps encoding the display mode in use. This code indicates range scale 20 NM

Fig.1 Comparison of display modes in 13-frame sequence (left) and in 14th frame (right)

A small dark feature visible against the ground return on frames 772-783 appears to match a similar feature on the 14th photo. In 772 this feature (appearing like a small "lake" and discussed as Feature #3 in *Section 5.i* below) appears at 312 degrees, about a half-radius out from the centre spot. This feature is also detectable on Frame 771 in a region of the tube not yet written on by the rotating scope trace, and partly for this reason is believed to be a system artifact. A corresponding display artifact or camera artifact on the sector scan, also appearing at 312 degrees at almost the same distance from the centre spot as in frame 783. This indicates that the sector scan photo probably shows the same scope in a different display mode, imaged by the same camera.

There is also a small (unexplained) systematic displacement of this artefact over the sequence 772-783 (*Section 5.i*), and its position on the sector scan suggests that this frame may have been taken a few seconds after frame 783, possibly as #784. Based on internal evidence of the migration of the small artifact mentioned above this sector scan will tentatively be numbered frame 784 here. On the other hand there are anomalies (see *Section 4*) so this is very uncertain; however there appear to be no unidentified echoes on this scan so the matter is of secondary importance. The rest of this analysis is principally concerned with the homogeneous sequence numbered 771-783, whose main features will now be described briefly.

3. Frame-by-Frame Description of Radarscope Photographs

- **Frame 771** The clock is set to Zulu time or GMT, and shows 0906 and 14 seconds (0406:14 local time, CDT). The sweep has completed approximately half of its first revolution and the 3 inner range rings are clearly visible in the central altitude-hole area, one at 0.75 NM, another at 1.25 NM and a third, brighter, ring at 1.75 NM (see *Section 4*, *Fig.2*). This area appears largely free of the speckling which increases later in the sequence. The edge of the surrounding bright area of ground return is sharply delineated at about 2.1 NM. A small discrete echo appears at azimuth 138 degrees, ahead and a few degrees to the right of the nose of the B-52 and just inside the third range ring, its nearer edge measured at 1.62 NM slant range (*Note 2*). This echo appears slightly elliptical with its major axis lying obliquely aslant the range axis (see contrast enhancement in *Section 7*, *Fig.8*).

- **Frame 772** 3 seconds later, at 0906 and 17 seconds, no echo is visible at the previous location but a similar discrete echo, distinctly elliptical and with its major axis similarly oblique, appears at 242 degrees, 1.05 NM, aft of the right wing.

- **Frame 773** 0906 and 20 seconds. Now the previous echo has decayed and a new echo, somewhat brighter and larger, but still very discrete, appears at 40 degrees azimuth, 1.05 NM off the *left* wing. The echo is also elliptical, this time its major axis oriented approximately on the PPI range axis. It also appears to be accompanied by, indeed conjoined with, a much smaller and fainter but still discrete secondary echo at slightly greater range (~ 1.15 miles) on roughly the same azimuth. (A very small and indistinct echo possibly also appears at about 138 degrees, range about 1.05 miles.) Picture resolution and/or contrast is deteriorating slightly. The inner 3/4-mile range ring is now virtually undiscernable.

- **Frame 774** 0906 and 23 seconds. There is no clear target echo on this scan. Background speckle inside the altitude hole is increasing.

- **Frame 775** 0906 and 26 seconds. The noise speckling is very evident on this scan.and both the first and second range rings are virtually invisible. Again there is no definite target echo, but a possible return is visible cutting the 1.75 NM ring at ~350 degs. The unique brightness of this feature (*Fig.2*), brighter than the brightest ground return on frame 775, may be due to a strong echo (perhaps augmented by the underlying range marker amplitude). Density contours measured by Claude Poher show characteristics that appear inconsistent with a radar noise artefact or print emulsion defect. It remains possible but not probable that it is a slightly blurred photo artefact introduced at print-projection stage.

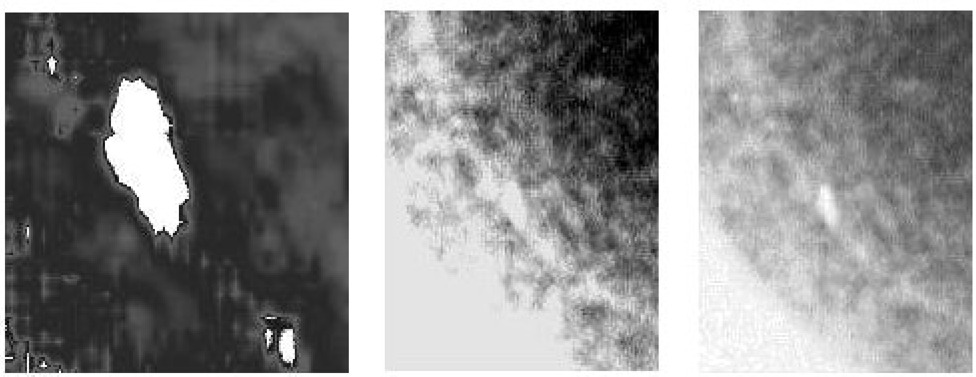


Fig.2. Detail of suspect "echo" from frame #775.

The original image (right) can be rendered at extreme contrast as a roughly oval "blip" (left). A noise artefact amplified by a fluctuation in the noisy 1.75 NM range ring (center) seems unlikely in view of the photometry. A photographic artefact remains a possibility.

- **Frame 776** 0906 and 29 seconds. An echo has now reappeared at the same azimuth and the same range as the double echo on frame 773, 40 degrees at 1.05 nautical miles. It covers the same radial extent as the double echo on frame 773, though it is less bright and not distinctly divided in two parts. (A pair of echoes can arguably be identified amid the speckles at about 1.5 miles range aft of the right wing, but they are only marginally above the noise level and may not be significant.)

- **Frame 777** 0906 and 32 seconds. There is again an echo at the same 40 degree bearing and slightly closer at 1.0 NM. This is a single compact echo, brighter again with no visible secondary echo and with only a small ellipticity. As in 773 and 776, the major axis of the ellipse is alligned approximately radially. (There is another possible echo aft of the right wing, a radial smudge sitting athwart the 1.75-mile range ring at 246 degrees. Possibly this is a close pair on the same azimuth. But again the noise level near the scope periphery means that the status of this echo is marginal.)

- **Frame 778** 0906 and 35 seconds. Another single compact echo at 40 degrees and 1.0 mile, again slightly elliptical, almost identical to 777.

- **Frame 779** 0906 and 38 seconds. Now there is a double echo again, still at 40 degrees, with two slightly less distinct and less bright components, of similar appearance, connected by a suggestion of a faint "bridge", at about 0.9 and 1.1 miles on the same radius.

- **Frame 780** 0906 and 41 seconds. Again a single bright, compact, elliptical echo, similar in appearance to 777 and 778, still at 40 degrees but now at about 0.95 mile.

- **Frame 781** 0906 and 44 seconds. An echo (or pair of echoes) somewhat similar in appearance and range to 779, but now at 39 degrees azimuth.

- **Frame 782** 0906 and 47/48 seconds. Still at 39 degrees, but now closer at about 0.87 NM, is a single, bright, compact and almost circular echo.

- **Frame 783** 0906 and 50/51 seconds. There are no unidentified point echoes visible during this scan. The altitude-hole area now appears free of noise and all three range rings and the heading marker are again distinct. The sharp edge of the surrounding ground return is by now closer, having moved steadily inward from about 2.15 NM slant range in 771 to about 1.8 NM in 783.

4. Radar Specs and Mode of Operation

Reconstructing from scattered partial sources the radar system installed in the B-52H as of 1968 has required a degree of forensic ingenuity. The AN/ASB series variants used on the B-52 included the High Speed Bombing Radar (HSBR), Improved High Speed Bombing Radar (IHSBR), Advanced Capabilities Radar (ACR) and - latterly - the fully digital Offensive Avionics System (OAS). But changes in the earlier analogue variants are mainly associated with the introduction of Terrain Avoidance (TA) mode with the monopulse ACR in about 1960, responding to a strategic change in the B-52 strike role from high-altitude to low-altitude penetration conceived in the late 1950s. The video displays associated with the new TA mode were available to the pilot and copilot on the flight deck, but fortunately left the scopes used by navigator and radar-navigator (of concern to us here) essentially unaffected. In particular, the Station Keep mode of the radar is functionally and operationally independent of those evolving special functions. The ACR remained basically unchanged until the conversion to digital OAS, which was still a decade or more in the future at the date of the incident.

In 1968 the 'H' variant flown by this elite crew of instructors was the state-of-the-art B-52 variant. The radar AN designation is believed to have been either the ASB-9 or the ASB-16. It was part of the IBM-Raytheon AN/ASQ-38 bombing-navigation system, along with the AN/AJA-1 True Heading Computer and AN/APN-89 Doppler Radar Set (for accurate doppler-drift ranging).

Most information here is extracted from a part copy of the ASB-4/9 Tech Order, Vol.1, Sec.4, and Bomb Navigation System Mechanic training manual CDC 32150K, Vol.4 for ASB-9/16A, supplemented by expert consultation as indicated in *Section 1*. (Hereinafter the designation ASB-9 is used for convenience.)

The Raytheon transmitter for the ASB-9 put out a peak power of 250 kW tunable over a 1 GHz range, between 8500 and 9500 MHz (or 8600 - 9600 MHz). An AUTO/MANUAL switch allows operator tuning or (usually) control by an Auto Frequency Control circuit.

There are two displays, a 10" Topographical Comparator scope and a 5" Azimith Range Indicator scope, available respectively to the Navigator and to the Radar-Navigator sitting at adjacent consoles. Both displays are fed with identical signals from the radar receiver. The larger 10" scope has the camera mounted on it.

The system can be used in several modes, combining full 360-degree rotation and sector scanning:

- *Radar Mode* - the PPI paints raw echoes with the antenna generally in continuous rotation
- *Beacon Mode* - mainly for tanker identification during refuelling (output fixed at 9285 MHz); the PPI displays only the coded signals from transponder beacons
- *Radar-Beacon Mode* - combined display showing raw paints and transponder codes
- *Altitude Calibrate Mode* - antenna pointed vertically down for auto updating of the aircraft altitude data stored by the computer
- *Terrain Avoidance Mode* - automatically plots a "clearance plane" by continually measuring ground elevations in a sector ahead of the a/c (antenna bore sight tilted down; sector width fixed at 90 degrees, 45 deg either side of a/c ground track; sector scan rate fixed at one cycle every 3 seconds; p.r.f. fixed 808 pps, p.w. fixed 1.0 microsec)
- *Indirect Bomb Damage Assessment Mode* - an automated sequence of ground-scan radar modes designed to map and photograph the target area during and after bomb release
- *Station Keep Mode* - coverage elevated, as an air navigation aid, primarily for formation flying and for lining up with the docking boom of an air-refuelling tanker.

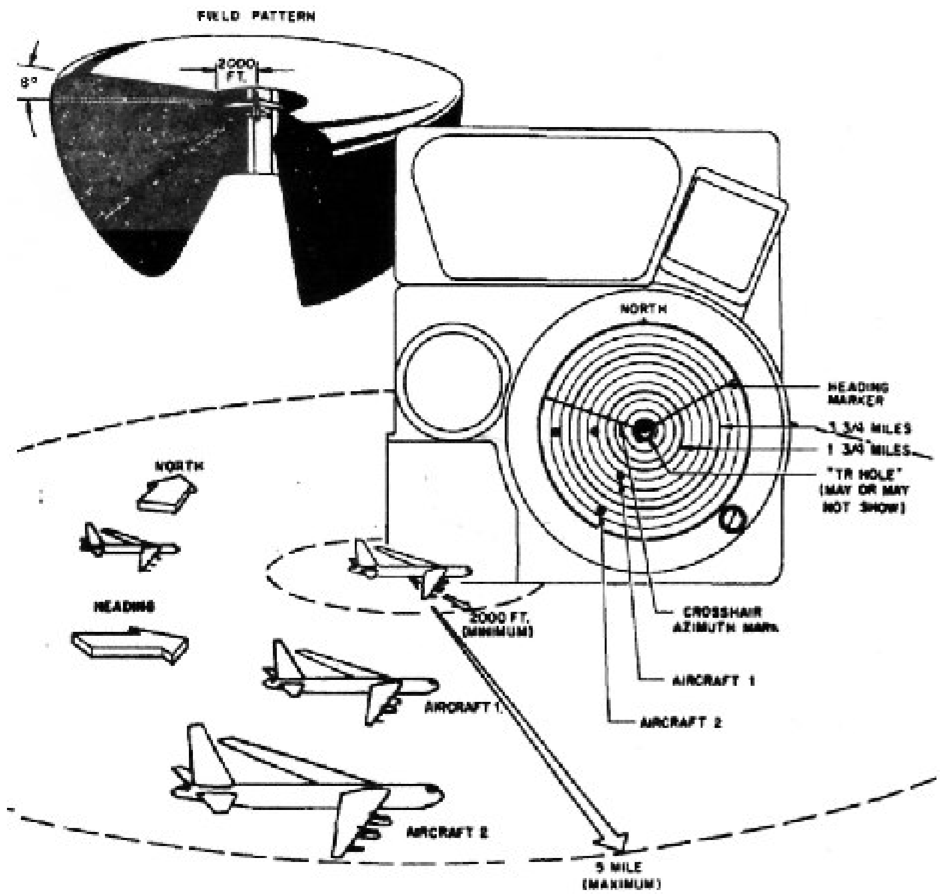


Fig.3 Station Keep schematic and PPI display mode

From training manual CDC 32150K, Vol.4. Note the radii of the range marker rings, at 0.5 NM intervals but with brightened markers at 1.75 and 3.75 NM. The first ring beyond the transmit-receive hole is here at 0.75 NM.

During the incident in question the radar was set in Station Keep mode (*Fig.3*). The following combinations of pulse-length and prf (pulse repetition frequency, in pulses per second or pps) are listed in the Tech Order, in addition to the special Terrain Clearance setting mentioned above:

0.25 microsec @ 1617 pps
0.5 microsec @ 808 pps
1.0 microsec @ 323 pps
2.25 microsec @ 323 pps (for Beacon Mode)

Notice that the pulse length and the pulse rate tend to vary inversely, so that for a fixed peak power the average power-on-target in the first two radar modes is the same, and is only 20% lower in the third. This is to do with range performance: Longer unambiguous range requires a longer interpulse time, delivering fewer pulses per beamwidth and a lower total energy over the dwell time of the target in the rotating beam; so to compensate a longer pulse is emitted and the average power-on-target remains constant. The trade off is range resolution, which begins to suffer as pulse length increases and so limits the use that can be made of this compensation (depending on design goals).

Apart from Beacon Mode, the applications of these settings are not identified. Specifically, the setting for Station Keep is not identified, but function and operation dictate that it will be the setting giving the finest range resolution at the shortest range.

We can infer unambiguous range. The reciprocal of the prf gives the maximum out-and-back path length for unambiguous range, so half that length gives the maximum design range. The corresponding ranges would be:

1617 pps	=	67.5 miles
808 pps	=	115 miles
323 pps	=	288 miles

The short range-scale requirement of Station Keep suggests that the appropriate setting is: 0.25 microsec @ 1617 pps., unambiguous range 67.5 miles. The theoretical range resolution of this beam (1/2 pulse length) would be 123 ft, or four times as good as the 490 ft resolution of a 1 microsecond pulse at 323 pps.

In continuous scan or sector scan modes the antenna rotation rate is variable. There appear to be only "slow" and "fast" settings. The fast scan is given as 17.5 - 22.5 RPM, which would be nominally 20 RPM consistent with the scope camera being triggered once per scan about every 3 seconds, confirming that the photos capture all the video data there was.

The reflector tilt angle is controllable by servo motors. There is a manual tilt control as well as automatic stabilisation governed (for attitude changes up to +/- 15 degrees) by pitch and roll signals from the ASQ-38 computer. The vertical beam angle (i.e. the vertical angular coverage) can be varied by independently controlling the phase of the signal to the feed horns (the horns were adjusted mechanically by servo motors in the earlier IHSBR). For Ground Map purposes this is done automatically as the depression angle of the antenna boresight varies: As the aircraft climbs the antenna has to be tilted down and at the same time the beam angle is narrowed so that the radar "footprint" on the ground remains constant.

The antenna produces a beam with a cosecant-squared vertical profile like an ATC or surveillance pattern turned upside down. Such a profile causes the antenna gain to vary inversely with depression angle in such a way that the echo intensity from the ground below the aircraft is reduced relatively to the echo intensity from longer slant ranges, and the brilliance of the coverage on the display tends thereby to be evened out. Another electronic circuit called a Sensitivity/Time Control or STC is available to amplify this swept gain when the effect of the cosecant-squared shaping is less effective in certain conditions.

The overall beam shape is the usual broad vertical fan, narrow in azimuth. This is actually a bi-lobe monopulse pattern produced by a 4-feedhorn antenna assembly. In ACR Terrain Avoidance mode the two lobes are squinted in elevation, effectively a "binocular" radar allowing sum-and-difference circuits in the ASQ-38 computer to compare echoes from the two lobes and so calculate accurate heights directly from range and antenna elevation data. For the purposes of PPI presentation in a surveillance mode, however, this computer function is to a large extent irrelevant. An Anti Jamming mode then becomes available by switching the pairing of the antenna feeds, so that the two lobes of the beam are now squinted in azimuth to allow Monopulse Sidelobe Reduction. MSR rejects signals that might otherwise be injected from emitters away from the bore-sight azimuth. But otherwise in Station Keep the PPI display is that of a simple pulse radar.

Manual CDC 32150K, Vol.4 gives the nominal horizontal beam width as 1.59 degrees; the overall vertical beamwidth is variable between about 54 and 60 degrees depending on antenna boresight elevation. As shown in *Fig.3*, in Station Keep the boresight angle is elevated, with the top edge of the "usable field pattern" set at +8 degrees above horizontal flight level, and it follows that the bottom edge of the vertical pattern can be taken as being between -46 and -52 degrees below flight level. This is only a guesstimate, however. The "usable field pattern" is evidently meant to be indicative of a contour of equiprobability of detection for a large jet (such as a B-52 or KC-135 tanker) out to the maximum display range of 5 NM. But no detailed gain figures are available, neither is the contour of the "usable field pattern" defined in terms of any specific operational criterion such as a probability of detection of a target of known RCS.

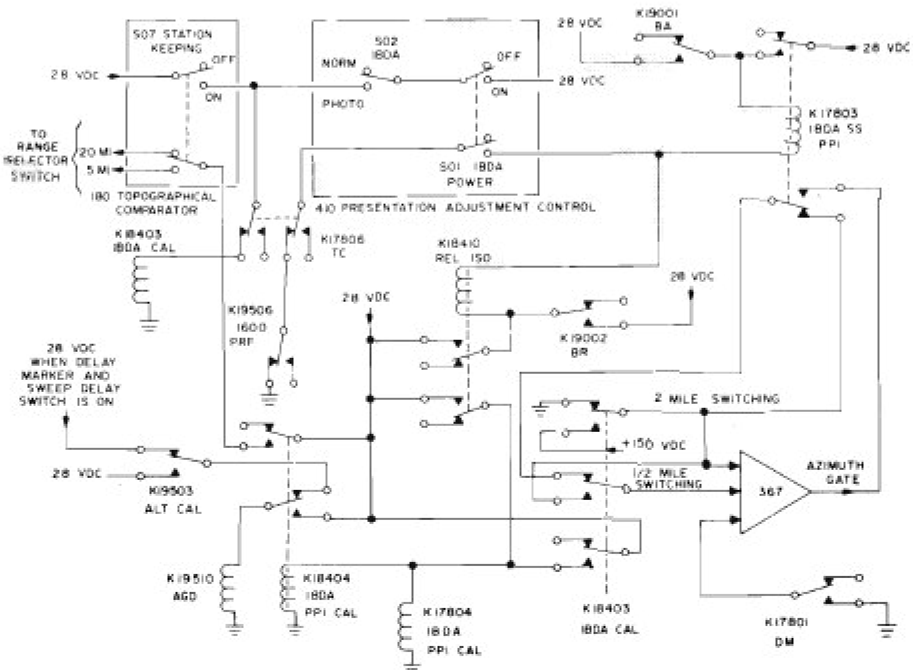


Fig.4. Station-Keeping/IBDA circuit diagram
from training manual CDC 32150K, Vol.4, p.46

We can see (*Fig.4*) that the Station Keep mode selector switch is coupled to the range scale selector switch and so enforces the special 5-mile PPI display range scale with 1/2-NM range rings. The ranges of these markers are shown in *Fig.3* above (see also *Note 2*). Other range-scale options available, in various full-scan PPI and off-centre sector-scan radar modes, are 10, 15, 20, 30 and 50 NM. Longer ranges are available by introducing a sweep delay. This circuit effectively regauges the zero-point of range by making the start of the PPI trace correspond to a non-zero echo time.

As mentioned, the radar system status is identified in these other modes by the sequence of lamps illuminated on the camera data plaque (as seen on frame 784) which replaces the clock and frame counter to the right of the PPI (seen on frames 771-783). The lamp codes are reproduced in *Fig.5*.

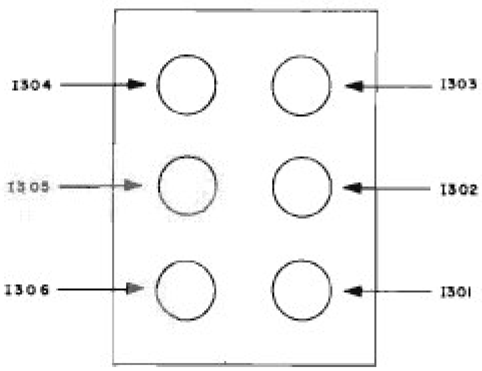


Figure 3-14. Camera data lamps.

NOTE:
- In offsets, lamp 2 will be illuminated in addition to those lamps listed under above conditions.
- During clockwise sector scan, lamp 3 will be illuminated in addition to those lamps listed under above conditions.
- Lamp numbers refer to the last digit of the lamps indicated in figure 3-14.

The lamp positions on the camera data plaque are shown in figure 3-14. Table 1-1 tabulates the lamps illuminated for the various codes that indicate system and operator operations. Note that only the last digit of each lamp number is used in the table.

RANGE TARGET SCALE	*HAND CONTROL (DEADMAN SWITCH)*	*MEMORY POINT*	*LAMP(S) ILLUMINATED (SEE FIGURE 2-16)*
10	OFF	OFF	1
10	ON	OFF	1 6
	OFF OR ON	ON	1 5
	OFF	OFF	4
15	ON	OFF	4 6
	OFF OR ON	ON	4 5
	OFF	OFF	5
20	ON	OFF	1 5 6
	OFF OR ON	ON	4
	OFF	OFF	6
30	ON	OFF	5 6
	OFF OR ON	ON	4 5 6
	OFF	OFF	NONE
50	ON	OFF	1 4 6
	OFF OR ON	ON	1 4 5
BOMB RELEASE			1 4 5 6

Fig.5 Camera data plaque codes
for radar modes other than Station Keep
From training manual CDC 32150K, Vol.4, p.53