CHAPTER 8

IDENTIFICATION EQUIPMENT

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LEARNING OBJECTIVES

After you finish this chapter , you should be able to do the following:

1. Describe a basic IFF system and how it operates.

2. Identify the AIMS MK XII IFF system components and explain their operation.

3. Explain the use of the AIMS MK XII equipment in a jamming environment and in emergency (Mode 4) operations.

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INTRODUCTION

Identification Friend or Foe (IFF) is the system that ships and stations use to identify friendly aircraft and ships. Since hostile aircraft, with their fast speeds, pose a greater threat than ships, we will concentrate on aircraft IFF procedures. However, some of the IFF procedures also can be used for identifying ships. Basically, the ship or station desiring to know whether an approaching aircraft is friendly sends out a special electronic signal in the direction of the aircraft. The signal triggers an electronic response from an IFF transmitter in friendly aircraft. This response signal, in turn, generates a coded symbol on the radar scope of the interrogating ship or station. This symbol, in addition to designating the contact as friendly, may provide such information as type of craft, squadron, side number, mission, course, and altitude. If the aircraft does not respond, it is classified as either "unknown" or "hostile".

IFF evolved in World War II, with each service developing its own equipment for its own particular requirements. This resulted in a variety of miscellaneous, specialized equipment with little or no interchangeability.

In 1963, the U.S. Armed Forces pooled their requirements and efforts under an Air Force project office and created a set of requirements for a new IFF system, designated AIMS. AIMS, an acronym of acronyms, stands for:

ATCRBS Air Traffic Control Radar Beacon System

IFF   Identification Friend or Foe

MK XII Mark XII

S   System

Today, all U.S. armed forces use the AIMS (Mark XII IFF) system, primarily to identify friendly units rapidly and positively. They also use AIMS for tracking and controlling aircraft. In the military world, high-speed aircraft present a critical problem in detection, identification, tracking, and evaluation. Time is extremely critical when aircraft are approaching at Mach (speed of sound) speeds. To provide ample time for initiating appropriate action, a ship must be able to detect and identify aircraft at the greatest possible distance. In operations involving friendly ships and aircraft, it is important to know not only the location but also the identity of each craft. For these reasons, all of the armed services use IFF equipment in conjunction with search radars.

In the civilian world, the increased numbers and speed of commercial aircraft (both domestic and international) presented problems for air traffic controllers. To overcome these problems, civilian authorities worldwide adapted IFF for civilian air traffic control. In the civil air traffic control environment, IFF is called Secondary Surveillance Radar (SSR).

IFF systems operate in one or more *modes*. A mode is the electronic method used to identify an aircraft and to display information about the aircraft on a radar

scope. A basic mode consists of one or two tones to indicate a friendly aircraft. Advanced modes add codes to the tone(s) to provide additional information about the aircraft. Civilian SSR systems operate in four modes designated as "A", "B", "C", and "D". Military IFF systems use four modes of operation, identified as mode 1 through mode 4.

The basic SSR (civilian) mode is mode A, which is essentially identical to the military mode 3; therefore, this mode is commonly referred to as mode 3/A. Mode B has very limited use and has no military equivalent. Mode C is reserved for automatic pressure altitude transmission and has been adopted for both civil and military altitude reporting. Mode D has not been established internationally.

Military modes 1, 2, and 4 have no civilian equivalent. Mode 1 is known as the general identification or mission signal and is used as directed by area commander instructions. Mode 2 provides the personal identification (PI) code for a specific airframe or ship; these codes are assigned by area commander notices. Mode 3/A uses codes for air traffic control within the Continental United States (CONUS) and for other purposes as directed by the operational command outside CONUS. It may be used in conjunction with "IFF Mark XII Mode 3/A Safe Passage Procedures" (AKAA 283 and 285 series). Mode 4 is used only to verify friendly status.

Since IFF/SSR is used internationally, you must be aware of the types of IFF systems used by friendly nations. Some countries use the Mark XII IFF, while others use the Mark X IFF. The Mark X system is available in three versions—basic Mark X, Mark X (SIF), and Mark X (A).

Basic IFF Mark X is the oldest IFF system still used by friendly nations. It can reply by mode only (codes are not available from the transponder). The basic reply for modes 1 and 3 is a single pulse. The response for mode 2 is two pulses spaced 16 microseconds (µs) apart. IDENT (I/P) and emergency feature are available. A low-receiver-sensitivity function is also available.

IFF Mark X (SIF) has a selective identification feature (SIF), which adds reply pulse coding to the basic IFF Mark X system, allowing operators to identify, track, and control friendly aircraft. The SIF was added to basic IFF Mark X because the system had low inherent security and did not allow operators to identify individual friendly aircraft The number of codes available is 32 in mode 1; 4,096 in mode 2; and

64 in mode 3. IDENT (I/P) and emergency features are also available.

IFF Mark X (A) is essentially the same as IFF Mark X (SIF) except that mode 3 provides 4096 codes has the SSR mode C added.

AIMS (IFF Mark XII) equipment is compatible with IFF Mark X (SIF) and IFF Mark X (A). In addition to operating in IFF Mark X modes 1 through 3, Mark XII equipment can also operate in mode 4. Mode 4 adds communications security equipment to the IFF system. AIMS equipment can also operate in mode C, which provides for automatic pressure altitude reporting.The AIMS equipment is capable of supporting diverse missions, such as surface warfare (SUW) and air warfare (AW), aerial and naval bombardment, and aerial and naval attack. It permits friendly forces to recognize each other and to distinguish themselves from neutral or hostile forces. The system also can serve as an auxiliary surveillance radar to assist in tracking friendly forces when the primary radar is obscured by clutter.

For detailed information on operations policy and SIF code assignments, refer to the classified documents listed in the references section at the end of this manual in Appendix I.

IFF SYSTEM OVERVIEW

A basic IFF system consists of an interrogator subsystem and a transponder subsystem. The interrogator transmits challenges (also called interrogations) on a frequency of 1,030 MHz. When a transponder on another craft receives a valid interrogation, it transmits (on 1,090 MHz) a response that designates the craft as friendly and may, depending on the system, also identify the craft. The interrogator receives the response and processes it for presentation on a radar scope. The interrogator subsystem is normally associated with a search or fire control radar and is called a "slaved" system. IFF interrogations are synchronized with the radar transmissions, with the interrogator pulse repetition frequency (PRF) usually equal to the radar PRF or a sub-multiple of it. The interrogations are transmitted slightly before radar zero-range time, allowing transponder replies to fall near the associated radar targets on a radar display console.

Interrogator subsystems that are not associated with a radar are called "black IFF" systems. For black IFF systems, the timing is usually adjusted so that target replies fall at the true target range and azimuth

on the display unit (plan position indicator (PPI)). Radar targets are not displayed with black IFF video. IFF interrogations are transmitted on a rotating directional antenna (usually mounted atop or as an integral element of a search radar antenna), and transponder replies are received on this same antenna. Transponders receive interrogations and transmit replies on an omnidirectional antenna.

A ship may be equipped with one or more interrogator subsystems, but only one transponder subsystem. In general, interrogators and transponders work independently of each other. The only interconnection between the two is a suppression signal to inhibit the ship's transponder from replying to the ship's own interrogators. The MK XII system was developed with two primary goals. The first goal was to provide improved air traffic control (ATC) for both civil and military aircraft, as well as a method for monitoring the identification codes of friendly military aircraft and surface vessels. The second goal was to furnish a crypto-secure method of identifying military craft.

Air traffic control, including the monitoring of friendly aircraft code, track, and altitude information, requires the use of the selective identification feature (SIF) modes 1, 2, 3/A, and mode C. Remember, numbered modes form part of the military IFF MK XII system; lettered modes are assigned to the civil air traffic control system. Ships can also be monitored with the SIF modes. A feature known as *interrogator side lobe suppression (ISLS)* inhibits transponder replies to all challenges not radiated in the main beam of the interrogating antenna. Without the ISLS feature, a close-range IFF target would appear at several different bearings on the display (a phenomenon known as *ring-around*). If ring-around appears on more than one target, it probably indicates a problem with the ship's interrogation system. All MK XII interrogators and transponders incorporate the ISLS function.

NOTE

Transponder systems without ISLS capability may be operated in the low-sensitivity position to reduce undesired replies from the antenna pattern side lobes.

Each mode 1, 2, or 3/A transponder reply represents a binary coded octal number. The desired octal reply code for each mode is dialed into the transponder by means of thumb-wheel switches. Reply codes available are as follows:

Mode 1	32 two-digit codes (00 to 73) , selected at the C6280A(P)/APK.
Mode 2	4096 four-digit codes (0000 to 7777), selected at the RT-859A/APX-72 front panel.
Mode 3/A	4096 four-digit codes (0000 ton 7777), selected at the C-6280A(P)/APX front panel.
Mode C	1278 four-digit codes. These codes represent altitudes from–1,000 feet to + 126,700 feet in 100-foot increments and are generated by an aircraft's barometric altimeter digitizer. Shipboard transponders reply to mode C interrogations with bracket pulses only (code 0000).
Mode 4	Computer-controlled crypto code, generated automatically according to a preset key list (AKAK 3662 series).

You cannot distinguish mode 1, 2, 3/A, and C by mode. Only the fact that the interrogator system "remembers" which mode it has just interrogated allows replies to be identified with the proper mode.
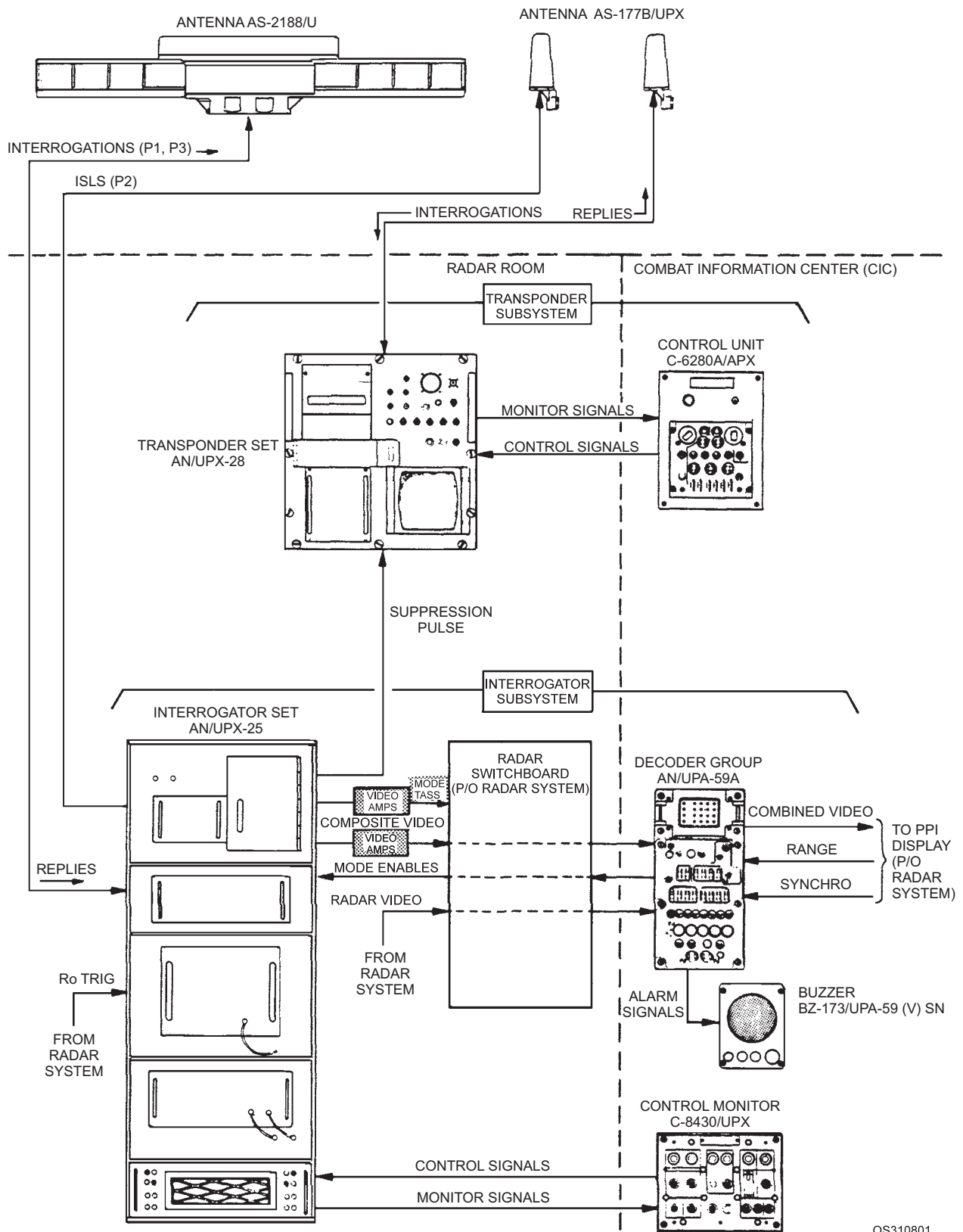
Mode 4 provides crypto-secure identification of friendlies. Mode 4 interrogations are computer-encoded pulse trains, which consist of four "sync" pulses and possibly an ISLS pulse (if it is not transmitted in the antenna's main lobe) followed by as many as 32 information pulses. Upon receipt of a valid mode 4 interrogation, the transponder computer processes the information "word" and generates a corresponding time-encoded three-pulse reply. The interrogator subsystem, in turn, receives the reply, converts it to one pulse, and time-decodes it for presentation on the indicators.

Q1. What two subsystems make up an IFF system?

Q2. What IFF mode provides the altitude of a contact? What range of altitudes does this mode indicate?

MK XII IFF EQUIPMENT OPERATION

Figure 8-1 shows a MK XII shipboard system. The dashed lines separate equipment that is connected electronically but located in different parts of the ship.

ANTENNA AS-2188/U

ANTENNA AS-177B/UPX

INTERROGATIONS (P1, P3)

ISLS (P2)

INTERROGATIONS

REPLIES

RADAR ROOM

COMBAT INFORMATION CENTER (CIC)

TRANSPONDER SUBSYSTEM

CONTROL UNIT
C-6280A/APX

MONITOR SIGNALS

CONTROL SIGNALS

TRANSPONDER SET
AN/UPX-28

SUPPRESSION
PULSE

INTERROGATOR SUBSYSTEM

INTERROGATOR SET
AN/UPX-25

RADAR
SWITCHBOARD
(P/O RADAR SYSTEM)

DECODER GROUP
AN/UPA-59A

VIDEO AMPS

MODE TASS

COMBINED VIDEO

TO PPI
DISPLAY
(P/O
RADAR
SYSTEM)

COMPOSITE VIDEO

VIDEO AMPS

RANGE

REPLIES

MODE ENABLES

SYNCHRO

RADAR VIDEO

Ro TRIG

FROM
RADAR
SYSTEM

ALARM
SIGNALS

BUZZER
BZ-173/UPA-59 (V) SN

FROM
RADAR
SYSTEM

CONTROL MONITOR
C-8430/UPX

CONTROL SIGNALS

MONITOR SIGNALS

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Figure 8-1.—Typical AIMS shipboard system.

The equipment shown to the right of the vertical dashed line, under COMBAT INFORMATION CENTER, is the equipment with which you will be most concerned. This equipment operates associated equipment located in the radar room. Notice that figure 8-1 also divides the equipment by sub-system—transponder and interrogator. We will discuss each system briefly.

TRANSPONDER SUBSYSTEM

Your ship will be equipped with one of two transponder subsystems—either the AN/APX-72 or the AN/APX-100. The AN/APX-100 was designed as a direct replacement for the AN/APX-72. The AN/APX-72, which is found in most shipboard naval configurations, consists of Receiver-Transmitter RT-859A/APX-72 and Transponder Set Control C-6280P/APX. The control unit is normally operated from a remote location in the combat information center. In comparison, the AN/APX-100 consists of Receiver-Transmitter RT-1157A/APX-100 and Transponder Set Control C-10533/APX-100, which again is normally operated from a remote location.

The two systems are functionally almost identical. However, the AN/APX-100 has several enhancements that are lacking in the AN/APX-72. The newer transponder is smaller, lighter and uses solid state transmitters and receivers, which greatly increases the reliability of the unit.

For airborne platforms, the AN/APX-100 has a diversity function that uses two separate antennas (ships use only one) and receiver circuits. This feature reduces the number of missed replies that are caused by the aircraft's angle in relation to the location of the interrogating platform. Another improvement introduced in the AN/APX-100 is the built-in test function. The self-tests performed by Transponder Test Set TS-1843/ APX, which was a separate unit in the older transponder, are performed by the RT-1157A/APX-100 without the need of additional test equipment. Also, the mode 4 self-test capability in the AN/APX-100 is a significant improvement over the AN/APX-72.

Transponder Set Control C-6280A(P)/APX

The Transponder Set Control C-6280A(P)/APX contains switches and indicators that allow an operator to turn on the transponder subsystem, to set in the reply codes for modes 1 and 3/A; to test modes 1, 2, 3/A, and C; to select the mode 4A or 4B code word; and to control the operation of the mode 4 computer or zero the mode 4 code. Figure 8-2 identifies each of the switches and indicators. Although you may be called on to operate this piece of equipment, your supervisor will normally operate it.

Transponder Set Control C-10533/APX-100

As we stated above, Transponder Set Control C-10533/APX-100 was designed to replace Transponder Set Control C-6280A(P)/APX Operationally, the two control units function similarly. The main difference is in the layout of the front panel controls and indicators. Figure 8-3 shows the layout of Transponder Set Control C-10533/APX-100. The most significant addition to the C-10533/APX-100 is the incorporation of the status indicators on the front panel.
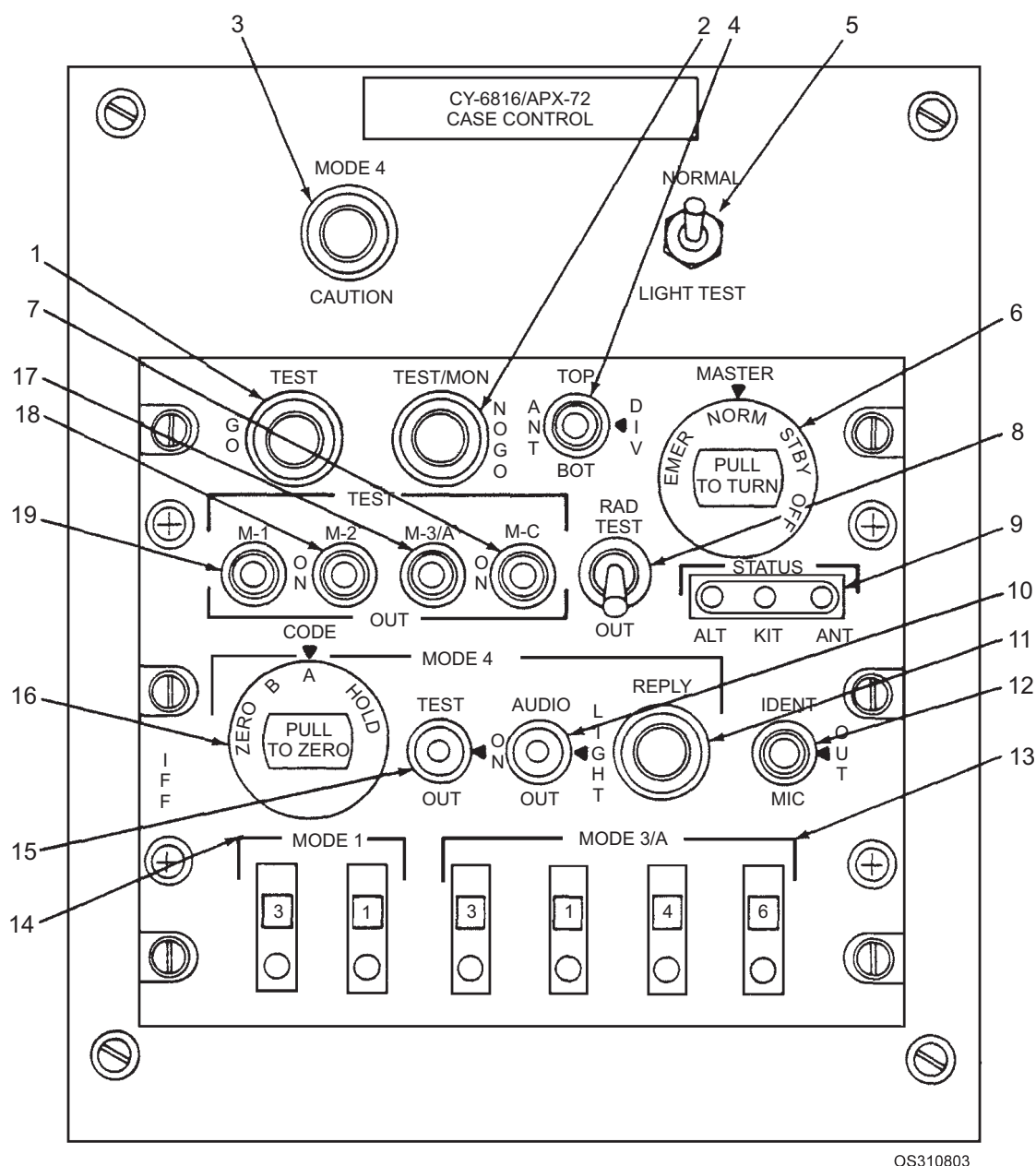
INTERROGATOR SUBSYSTEM

The two pieces of equipment of concern to you in the interrogator group are the *decoder group* and the *control monitor*. Our discussion on the decoder group is somewhat lengthy, so we will cover the control monitor first.

Control Monitor C-8430/UPX

The Control-Monitor C-8430/ provides remote control and remote indication for certain key functions of the interrogator subsystem. Figure 8-4 shows the controls and indicators you will find on the C-8430/UPX Control-Monitor. The two functions of primary concern to you are the *defruite*r function and the *mode 4* function.

The defruiter controls provide remote control for the Interference Blanker MX-8758/UPX (defruiter). The defruiter removes non-synchronous transponder replies (that is, replies responding to other interrogations-known as "fruit") and noise from received video.

Recall that mode 4 is used for crypto purposes. The mode 4 controls provide remote control for certain functions of the KIR-1A/TSEC computer.The control settings on this component affect the total interrogator system operation, including all decoders and NTDS equipment selecting this system. The control-monitor should be operated only by qualified personnel, knowledgeable in overall system operation. There will be one Control-Monitor C-8430/UPX for each interrogator subsystem aboard ship.

Figure 8-2.—Transponder Set Control C-6280A(P)/APX in Control Enclosure CY-6816/APX-72.

1. Code switch
2. Mode 4 Caution indicator
3. Replay indicator
4. Test indicator
5. Normal/Light Test indicator
6. Master switch
7. M-3/A switch
8. M-C switch
9. Rad Test/Out/Mon switch
10. M-2 switch
11. Ident/Out/Mic switch
12. Mode 3/A code select switches
13. Mode 1 code select switches
14. Mode 4 switch
15. M-1 switch
16. Audio/Out/Light switch

CY-6816/APX-72
CASE CONTROL

OS310803

1. Test Go indicator
2. Test/Mon No Go indicator
3. Mode 4 Caution indicator
4. Ant Top/Div/Bot switch
5. Light Test switch
6. Master control
7. M-C switch
8. Rad Test/Out switch
9. Status indicator
10. Audio/Out/Light switch
11. Reply indicator
12. Indent/Out/Mic switch
13. Mode 3/A switches
14. Mode 1 switches
15. Mode 4 switch
16. Code switch
17. M-3/A switch
18. M-2 switch
19. M-1 switch

Figure 8-3.—Transponder Set Control C-10533/APX-100 mounted in Enclosure CY-6816/APX-72.
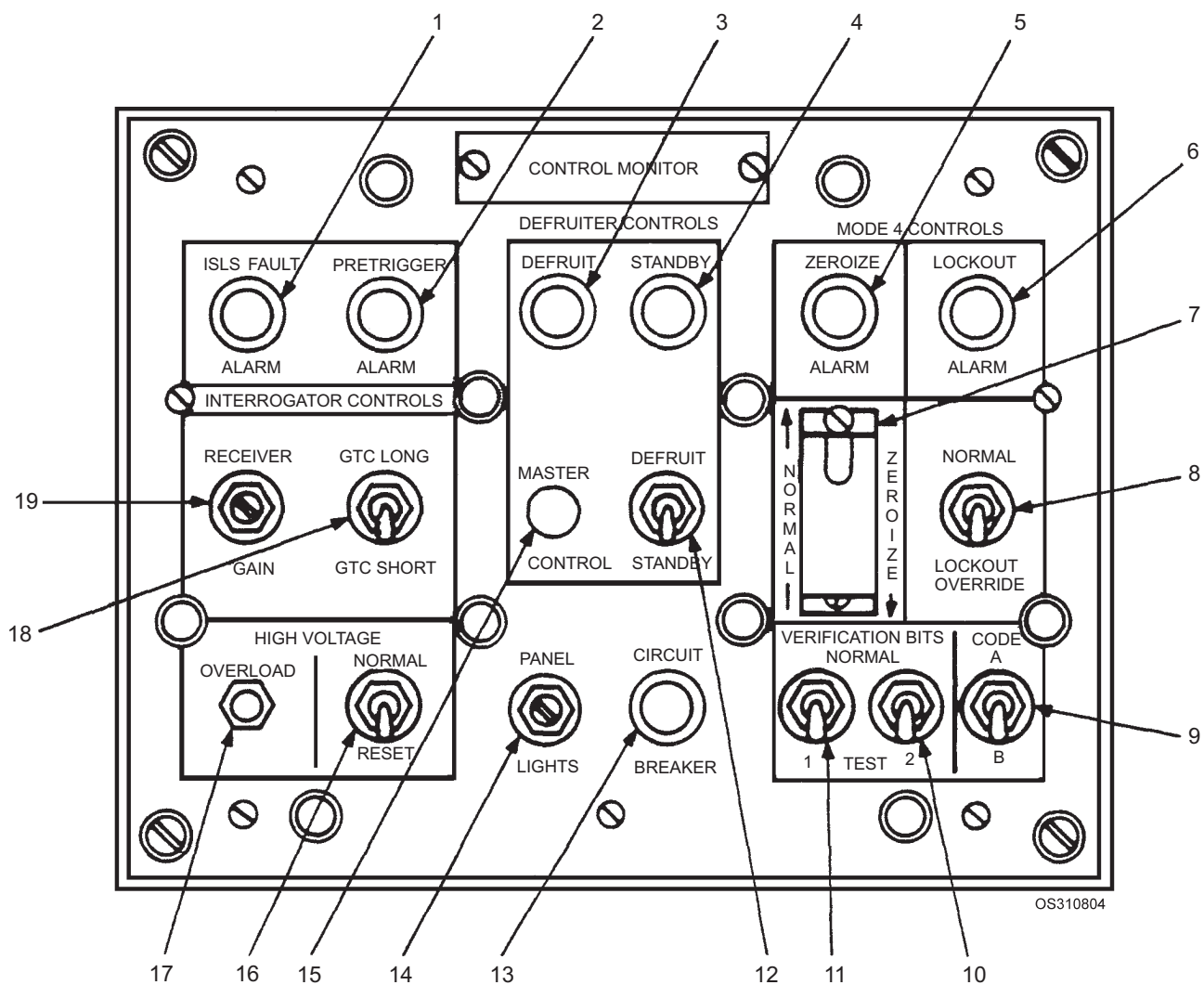
1. ISLS Fault Alarm indicator
2. Pretrigger Alarm indicator
3. Defruit indicator
4. Standby indicator
5. Mode 4 Zeroize Alarm indicator
6. Mode 4 Lockout Alarm indicator
7. Mode 4 Normal/Zeroize switch
8. Mode 4 Normal/Lockout Override stitch
9. Mode 4 Code switch
10. Verification Bit 2
11. Verification Bit 1
12. Defruit/Standby switch
13. Circuit breaker
14. Panel Lights dimmer control
15. Defruiter Master Control indicator
16. Interrogator High Voltage Normal/Reset switch
17. Interrogator High Voltage Overload indicator
18. Interrogator GTC Long/GTC Short switch
19. Interrogator Receiver Gain control

Figure 8-4.—Control-Monitor C-8430/UPX.

Decoder Groups AN/UPA-59, 59A, and 59B(V)

The AN/UPA-59 Decoder Group is a combination decoder/interrogator set remote control unit. It allows you to select the mode (and code) you desire to interrogate and to process the IFF video replies for presentation. It also provides remote challenge and emergency alarm indications.

Three different models of decoder groups are used with the interrogator subsystem: AN/UPA-59(V), AN/UPA-59A(V), or AN/UPA-59B(V).
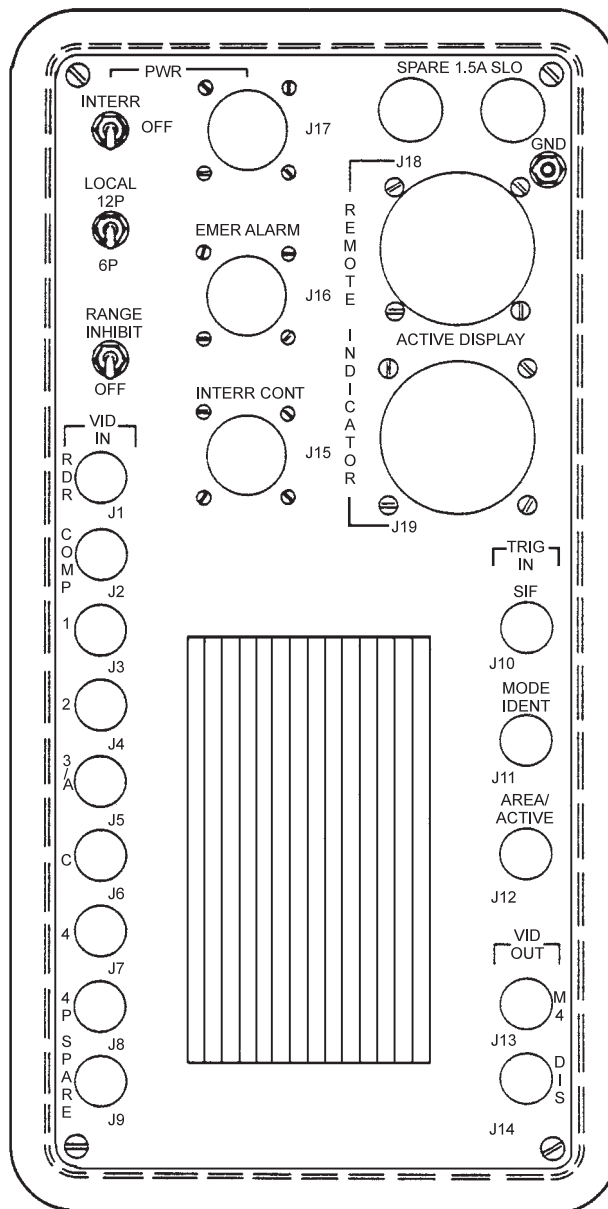
DECODER GROUP AN/UPA-59(V).— Decoder Group AN/UPA-59(V) (Figures 8-5 and 8-6) consists of three major components: Video Decoder KY-657(P)/UPA-59(V), Intratarget Data Indicator ID-1447/UPA-59(V), and Alarm Monitor BZ-173/UPA-59A(V).

The Video Decoder KY-657(P)/UPA-59(V) allows you to control the interrogation mode and the passive decoding of IFF replies. It also enables you to select the video to be sent to the radar repeater/display unit.
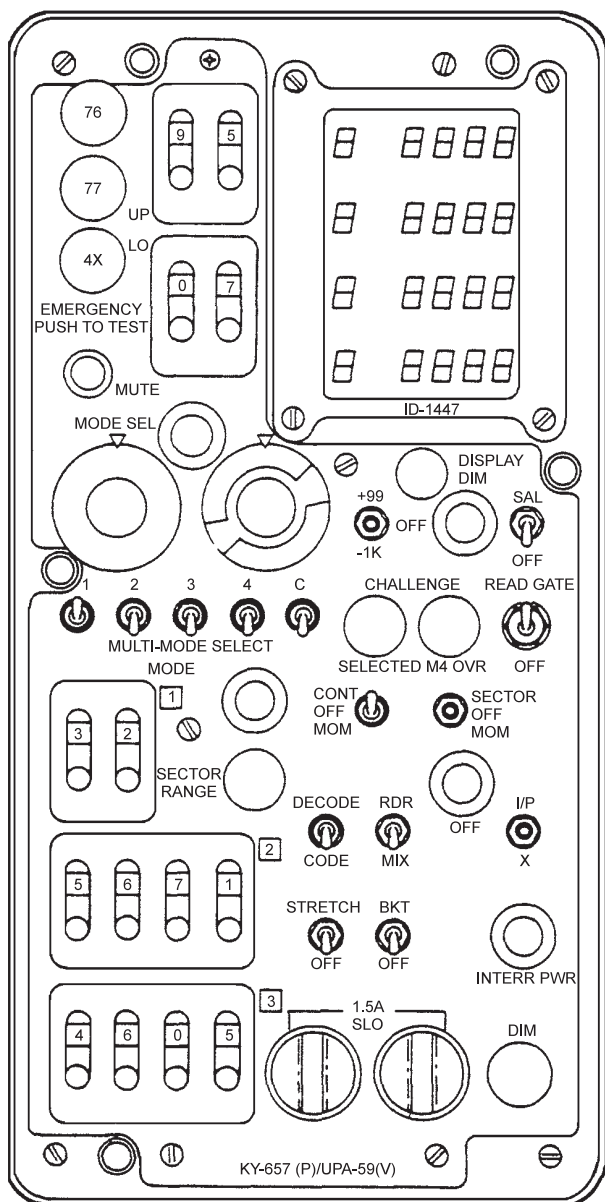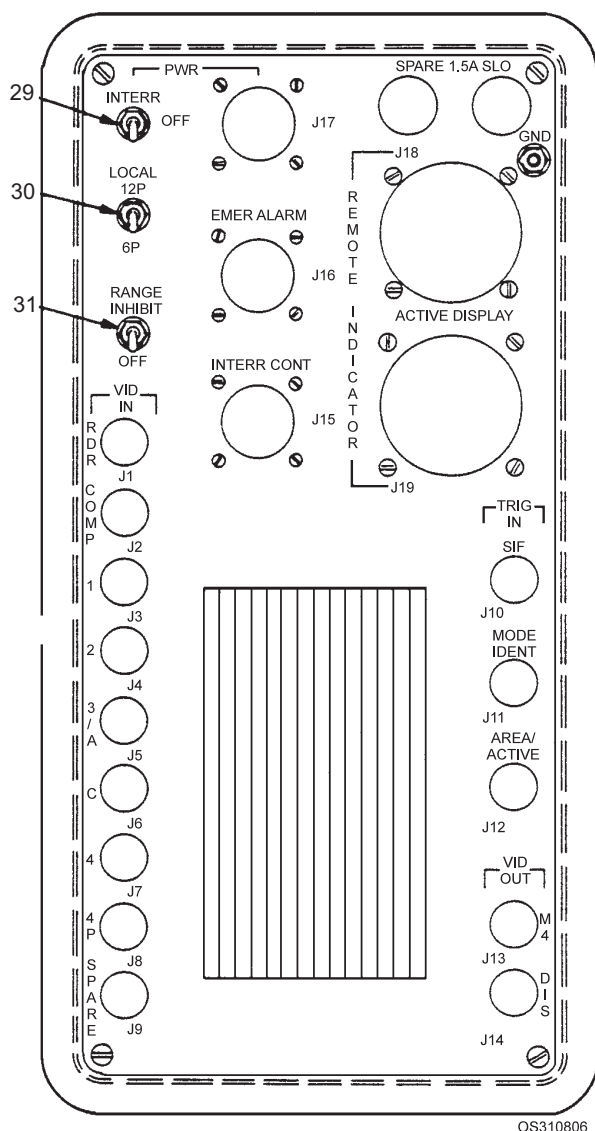

A. FRONT VIEW OF VIDEO DECODER

B. REAR VIEW OF VIDEO DECODER

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Figure 8-5.—Decoder Group AN/UPA-59(V2) front and rear panels.

29. Pwr Local/Off/Interr switch
30. 12P/6P switch
31. Range Inhibit/Off switch

Figure 8-6.—Decoder AN/UPA-59 controls (rear panel).

The Intratarget Data Indicator ID-1447/UPA-59(V) displays a code readout for modes 1, 2, 3/A, and C.

The Alarm Monitor BZ-173/UPA-59A(V) notifies you that an aircraft is "squawking" (transmitting) an emergency code and needs your attention.

DECODER GROUP AN/UPA-59A(V).— Decoder Group AN/UPA-59A(V) (Figure 8-7) consists of Video Decoder KY-761(P)/UPA-59A(V), Intratarget Data Indicator ID-1844/UPA-59A(V), and Alarm Monitor BZ- 173A/UPA-59(V).

Video Decoder KY-761(P)/UPA-59A(V) functions substantially the same as the KY-657(P)/UPA-59(V).

Intratarget Data Indicator ID-1844/UPA-59A(V) functions the same as the ID- 1447/UPA-59(V).

Alarm Monitor BZ- 173A/UPA-59(V) functions the same as the BZ-173/UPA-59(V).

DECODER GROUP AN/UPA-59B(V).— Decoder Group AN/UPA-59B(V) (Figure 8-8) consists of Video Decoder KY-761A(P)/UPA-59A(V)[P/O AN/UPA-59B(V)], Intratarget Decoder Indicator ID-1844A/UPA-59A(V)[P/O AN/UPA-59B(V)], and Alarm Monitor BZ-173A/UPA-59(V).

Video Decoder KY-761A(P)/UPA-59A(V)[P/O AN/UPA-59B(V)] functions substantially the same as the KY-657(P)/UPA-59(V).

Intratarget Decoder Indicator ID-1844A/UPA-59A(V)[P/O AN/UPA-59B(V)] functions the same as the ID-1447/UPA-59(V).

Alarm Monitor BZ-173A/UPA-59(V) functions the same as the BZ-173/UPA-59(V).

Note: Decoder Group AN/UPA-59B(V) appears the same as Decoder Group AN/UPA-59A(V) except for the BKT/OFF switch which becomes a three position switch labeled BKT/OFF/ALL.

Two configurations of the decoder groups are used in today's Navy: Variation 1, (V)1, consists of a video decoder and the alarm monitor. This configuration is referred to as a *passive* decoder. Passive functions are those that "filter" information to the indicator for display. Variation 2, (V)2, adds the intratarget data indicator to variation 1. This configuration is known also as an *active* decoder. Active functions are those in which the codes of targets in the active area on the display are read out on the intratarget data indicator.

The active and passive decoders perform passive decoder functions in the same manner. The (V)2 configuration adds active decoding capabilities to the passive functions of the (V)1 configuration. Passive and active functions are separate. In fact, under certain operational conditions, active readouts can occur for targets whose IFF video is not displayed on the associated indicator. We will address the active and passive functioning separately, with the discussion on passive decoding applying to the (V)1 configuration, and the discussion on **both** passive and active decoding applying to the (V)2 configuration.
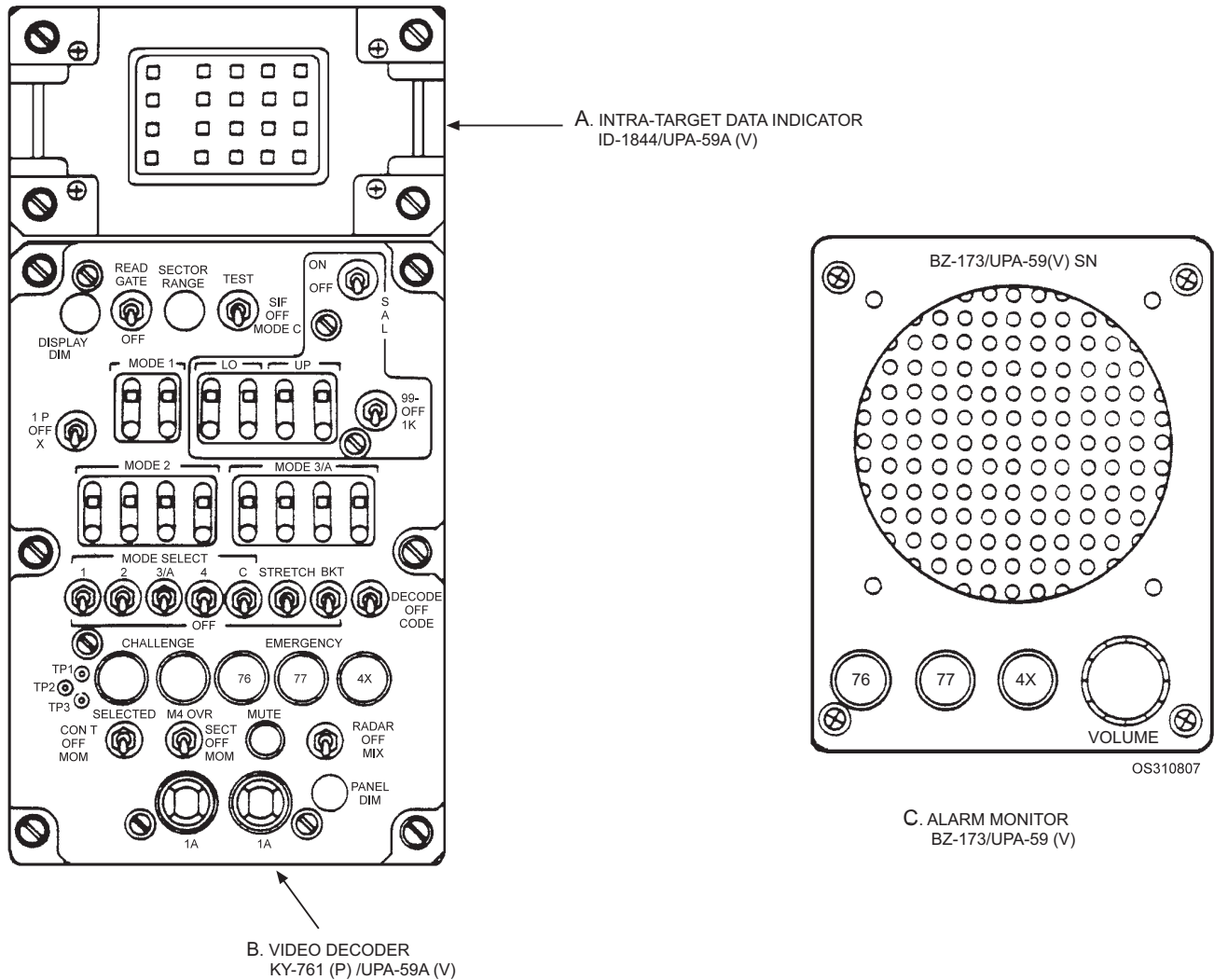
A. INTRA-TARGET DATA INDICATOR
ID-1844/UPA-59A (V)

B. VIDEO DECODER
KY-761 (P) /UPA-59A (V)

C. ALARM MONITOR
BZ-173/UPA-59 (V)

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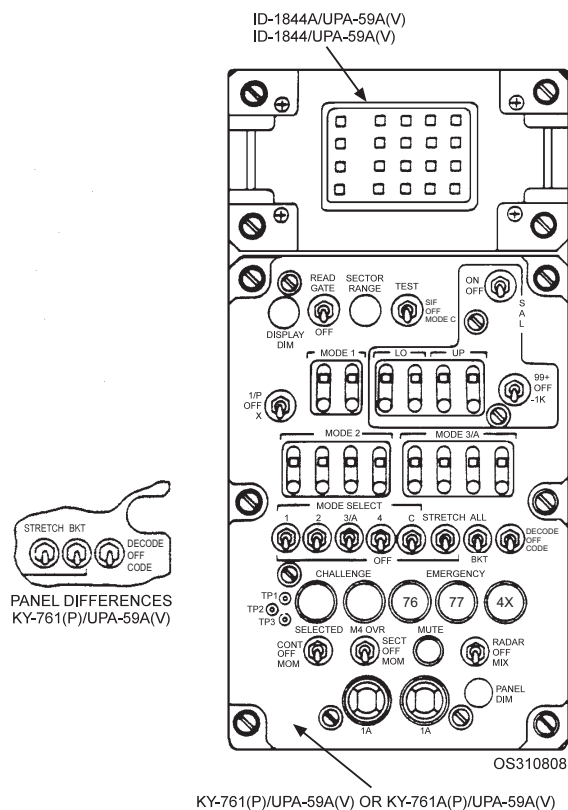**Figure 8-7.—Decoder Group AN/UPA-59A(V2).**

NOTE

If more than one decoder is used in an operational area (e.g., surface search), only one video decoder needs to be configured with an alarm monitor.

DECODER SWITCH SETTINGS AND DISPLAYS.—Switch positions for the AN/UPA-59's various modes of operation are listed in table 8-1; switch positions for the AN/UPA-59A and AN/UPA-59B are listed in tables 8-1 and 8-2. You can energize an active or passive decoder by using the three switches located on the decoder's rear panel. See figure 8-6 for the rear panel of AN/UPA-59, and figure 8-9 for the rear panel of AN/UPA-59A and 59B, which are basically the same.

Power LOCAL/OFF/INTRG Switch (29).—This switch energizes the video decoder. When the switch is in the INTRG position, the associated interrogator must be ON. When it is in the LOCAL position, the associated interrogator need not be on. Power must be applied to the associated display unit for both switch positions to function. The normal position of the switch is INTRO; the LOCAL position is reserved for emergency operation only. The interrogator associated with a video decoder group is selected automatically when a radar is selected at the PPI.

Figure 8-8.—Decoder Group AN/UPA-59B(V2).

NOTE

The POWER DISABLE switch, located internally (fig. 8-10), must be in the ON position; otherwise, the POWER- LOCAL/ OFF INTRO switch will not energize the decoder.

12P/6P Switch (30)—When the 12P/6P switch is in the 6P position, the decoder will decode six-pulse replies (i.e., the A and B digits only) for modes 2 and 3. When it is in the 12P position, the decoder will decode twelve-pulse replies (i.e., the A, B, C, and D digits) for modes 2 and 3. The normal position is 12P.

RANGE INHIBIT/OFF Switch (31).—The RANGE INHIBIT position of this switch prevents the decoding of false emergency replies from a close-range target. The inhibit range is internally adjustable and normally is set for 5 miles. The switch
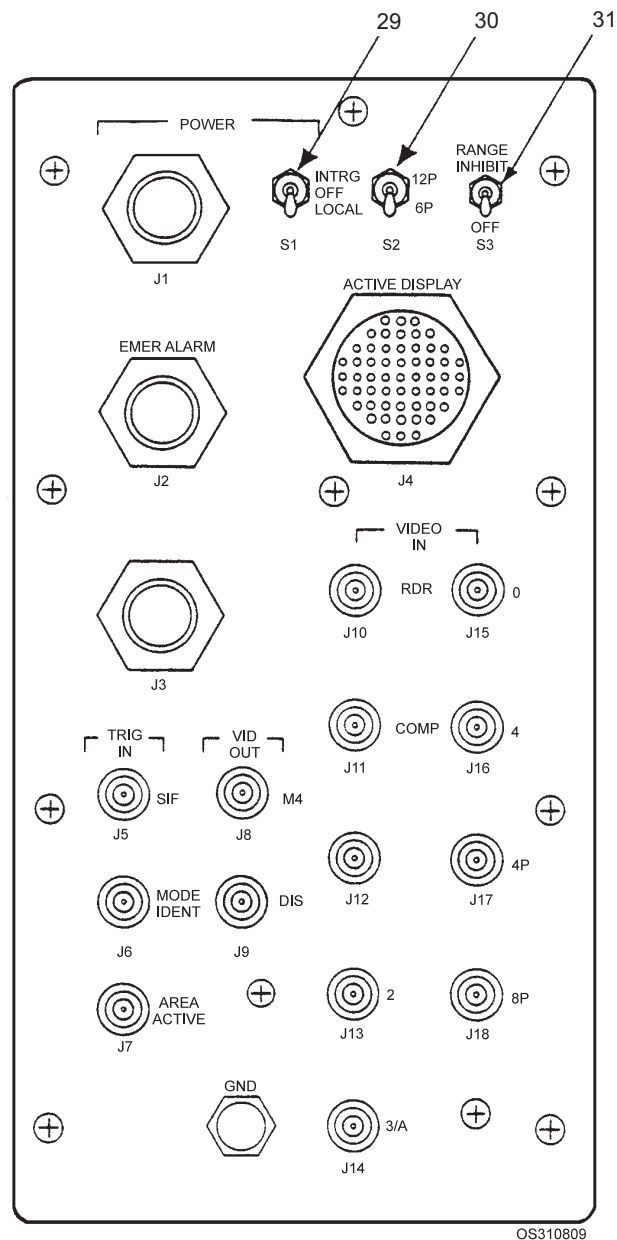
29. Power Local/OFF/Intrg switch
30. 12P/6P switch
31. Range Inhibit/Off switch

Figure 8-9.—Decoder AN/UPA-59A and 59B controls (rear panel).

does not affect emergency replies from targets beyond the set range. The normal switch position is OFF. When your ship is operating within 5 miles of units doing preflight testing, use the RANGE INHIBIT position to prevent decoding false emergency replies.

Table 8-1.—Decoder Control Positions for Desired Functions

Desired Function	CONTROL POSITIONS																
	*Mode Select	**Test/ Parity	***Multi-Mode Select	Selected	Code/ Decode	RDR/ Mix	Bkt	Stretch	IP/X	Code Switches	Sal	Up	Lo	+99/-1K	M4 Over	Read Gate	6P/12P
Code Display	Note 2	Off	Note 3	Cont	Code	Off or Mix	Off	Note 1	Note 1	Note 1	Off	Note 1	Note 1	Note 1	Off	Note 4	Note 1
Passive Decode	Note 10	Off	Note 3	Cont	Decode	Off or Mix	Off	Note 8	Note 7	Set selected mode to desired code	Off	Note 1	Note 1	Note 1	Off	Note 4	Note 6
Bracket Decode	Note 5	Off	Note 3	Cont	Decode	Off or Mix	Bkt	Off	I/P or Off	Note 1	Off	Note 1	Note 1	Note 1	Off	Note 4	Note 1
Stretched Passive Decode plus Bracket Decode	Note 5	Off	Note 3	Cont	Decode	Off or Mix	Bkt	Stretch	Note 7	Set selected mode to desired code	Off	Note 1	Note 1	Note 1	Off	Note 4	Note 6
I/P Decode	Note 10	Off	Note 3	Cont	Note 8	Off or Mix	Note 8	Note 8	I/P	Note 9	Off	Note 1	Note 1	Note 1	Off	Note 4	Note 6
X-Pulse Decode Display	Note 10	Off	Note 10	Cont	Decode	Off or Mix	Off	Off	X	Set selected mode to desired code	Off	Note 1	Note 1	Note 1	Off	Note 4	Note 6
Stretched X-Pulse Decode Plus Bracket Decode	Note 10	Off	Note 10	Cont	Decode	Off or Mix	Bkt	Stretch	X	Set selected mode to desired code	Off	Note 1	Note 1	Note 1	Off	Note 4	Note 6
4X Emergency	Note 11	Off or any Parity Mode	Note 11	Cont	Note 1	Off or Mix	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Off	Note 1	Note 1
7600 Emergency	Note 12	Off or any Parity Mode	Note 12	Cont	Note 1	Off or Mix	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Off	Note 1	Note 1

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Table 8-1.—Decoder Control Positions for Desired Functions (Continued)

Desired Function	CONTROL POSITIONS																
	*Mode Select	**Test/ Parity	***Multi-Mode Select	Selected	Code/ Decode	RDR/ Mix	Bkt	Stretch	IP/X	Code Switches	Sal	Up	Lo	+99/-1K	M4 Over	Read Gate	6P/12P
7700 Emergency	Note 12	Off or any Parity Mode	Note 12	Cont	Note 1	Off or Mix	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Off	Note 1	Note 1
Combined Emergency	Note 12	Off or any Parity Mode	Note 12	Cont	Note 1	Off or Mix	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Off	Note 1	Note 1
Sal Decode UPA-59A/B	Mode C			Cont	Decode or Off	Off or Mix	Off	Off	Note 1	Note 1	Sal	Note 13	Note 13	Note 14	Off	Note 4	Note 1
Sal Parity Code Display UPA-59 only	Select Mode C plus desired parity mode	Set for desired Parity Mode	Note 3	Cont	Code	Off or Mix	Off	Off	Note 1	Note 1	Sal	Note 13	Note 13	Note 14	Off	Note 4	Note 1
Sal Parity Decode Display UPA-59 only	Select Mode C plus desired parity mode	Set for desired Parity Mode	Note 3	Cont	Decode	Off or Mix	Off	Stretch	Note 8	Set Parity mode to desired code	Sal	Note 13	Note 13	Note 14	Off	Note 4	Note 6
Sal Bracket Decode Disply UPA-59 only	C or Multi-Mode	Off	Note 15	Cont	Note 1	Off or Mix	Bkt	Off	Off	Note 1	Sal	Note 13	Note 13	Note 14	Off	Note 4	Note 1
Sal Bracket Decode plus Sal Parity Decode UPA-59 only	Select Mode C plus desired parity mode	Set for desired Parity Mode	Note 3	Cont	Decode	Off or Mix	Bkt	Stretch	Note 8	Set Parity mode to desired code	Sal	Note 13	Note 13	Note 14	Off	Note 4	Note 6
Mode 4 Sector Override	Note 8	Off or Parity	Note 3	Note 8	Note 8	Off or Mix	Note 8	Note 8	Note 8	Note 8	Note 8	Note 8	Note 8	Note 8	Sector	Note 4	Note 8
Mode 4 Momentary Override	Note 8	Off or Parity	Note 3	Note 8	Off or Mix	Note 8	Note 8	Note 8	Note 8	Note 8	Note 8	Note 8	Note 8	Note 8	MOM as desired	Note 4	Note 8

OS3108t2

NOTES:

1. Switch position is immaterial.

2. Any mode or combination of modes is selectable as desired by operator.

3. Switch positions are immaterial unless MULTIMODE is selected on the MODE SEL switch in which case the multimode switches determine which modes are enabled.

4. The READ GATE switch is used to enable active readout, plus active area gate for display.

5. Any mode or combination of modes selectable. Mode 4, if selected, will be passed to the PPI directly.

6. Selection of 12P causes all four digits of a mode 2 or mode 3 reply code to be decoded. Selection of 6P causes decoder to ignore the last wo (C and D) digits for decoding.

7. Selection of I/P causes stretched slash to follow reply of targets transmitting an I/P code. Selection of the X position requires presence of X-pulses (signifying pilotless aircraft) in the reply code, in addition to the requirement that the reply code match the associated mode code switch setting, for passive decode to occur.

8. Selectable as desired by operator.

9. Set the desired code for selected mode if in passive decode format.

10. Modes 1. 2. 3/A or any combination thereof may be selected. Mode 4 video, if selected, will be passed to the PPI, unprocessed by the decoder.

11. Any mode or combination of modes containing at least one of modes 1, 2, 3/A may be selected.

12. Mode 3/A or any combination of modes including mode 3/A may be selected.

13. Set for desired altitude layer.

14. Plus 99 eliminates upper SAL limit, -1k eliminates lower SAL limit.

15. Mode C or any combination of modes including mode C.

* Mode SEL switch on UPA-59 only
** Parity selection on UPA-59 only
*** MULTI-MODE SELECT switches labeled MODE SELECT on UPA-59A/B decoders

Table 8-2.—Operator's Control Functions

	SAL	STRETCH	BKT	DECODE OFF CODE	DISPLAYED VIDEO
1	ON	ON	ALL or BKT	DECODE	All mode C within UP and LO SAL limits and all passively decoded replies stretched. Remaining targets show a single slash due to bracket decoding.
2.	OFF	ON	ALL or BKT	DECODE	Same as 1. above, but without mode C.
3.	ON	OFF	ALL or BKT	DECODE	All targets display single slash with no differentiation for SAL, bracket decoded, or passively.
4.	OFF	OFF	ALL or BKT	DECODE	Same as 3. above, but without mode C.
5.	ON	ON	OFF	DECODE	All passively decoded replies and all SAL stretched.
6.	OFF	ON	OFF	DECODE	All passively decoded replies stretched.
7.	ON	OFF	OFF	DECODE	All passively decoded replies and all SAL display single slash.
8.	OFF	OFF	OFF	DECODE	All passively decoded replies display single slash.
9.	(1)	(1)	ALL or BKT	OFF	All targets display single slash (includes mode C targets, if SAL turned on).
10.	ON	ON	OFF	OFF	All SAL targets within UP & LO SAL limits stretched.
11.	OFF	(1)	OFF	OFF	Emergency replies only.
12.	ON	OFF	OFF	OFF	All SAL targets within UP & LO SAL limits.
13.	(1)	(1)	(1)	CODE	IFF info pulses (raw video).

NOTE: (1) Switch position is immaterial.

NOTE

The remaining controls are located on the front panel. See figure 8-11 for the AN/UPA-59, and figure 8-12 for the AN/UPA-59A or AN/UPA-59B.

Panel Lighting DIM Control (14).—The DIM control adjusts panel light brightness.

READ GATE Switch (functions with (V) 2 only) (2).—In the READ GATE position, this switch activates the active readout display.

SECTOR RANGE control (functions with (V)2 only) (3).—This control adjusts the range (length) of the target sector gate (active area gate). See figure 8-13.

Active Readout Lighting (intratarget data indicator) DISPLAY DIM Control (functions with (V)2 only) (28).—This control adjusts the readout for desired brightness.

CAUTION

When a decoder SELECTED CONT/OFF/ MOM switch is left in the CONT position, the interrogator set may transmit challenges even when the decoders are powered OFF (if any modes are selected).
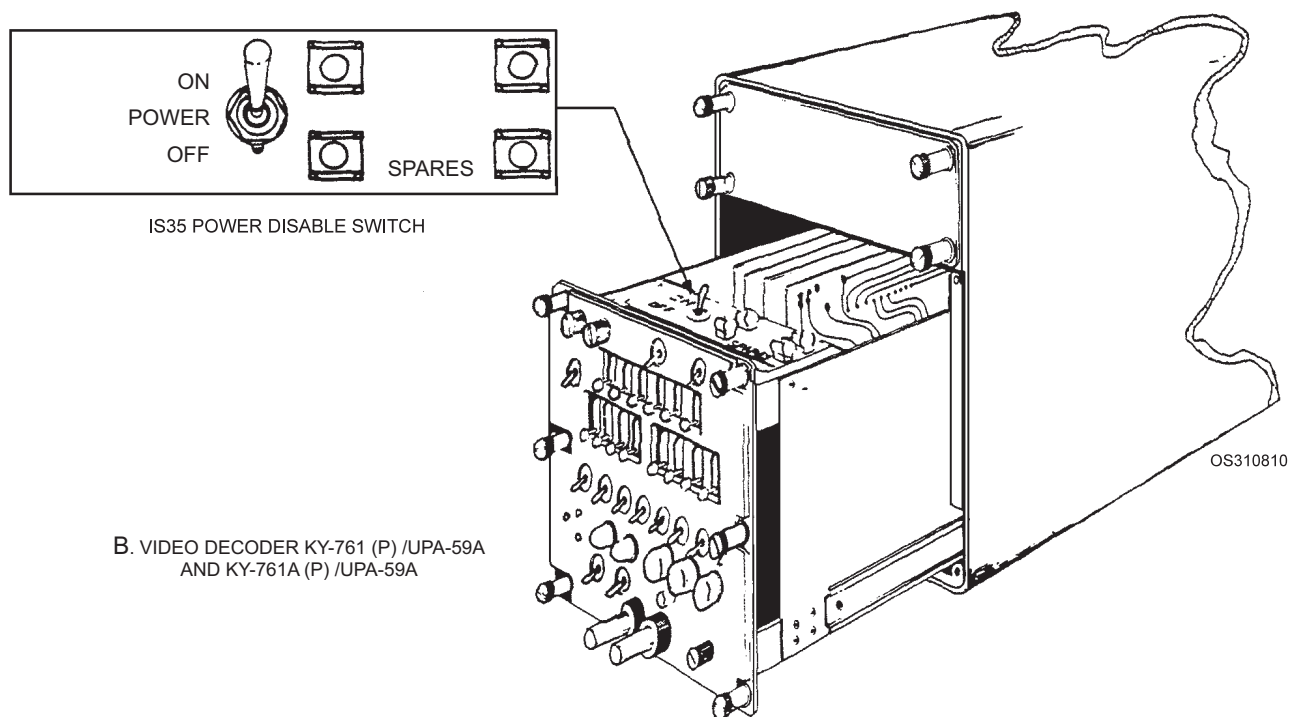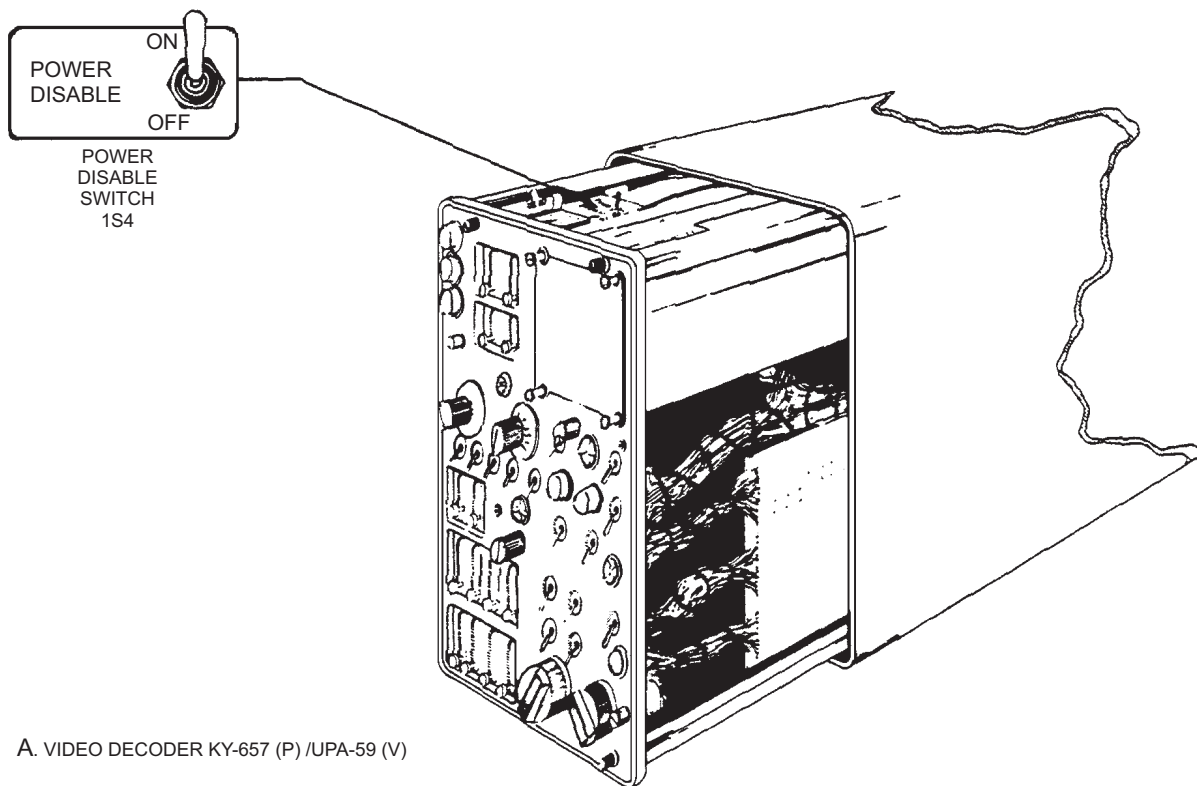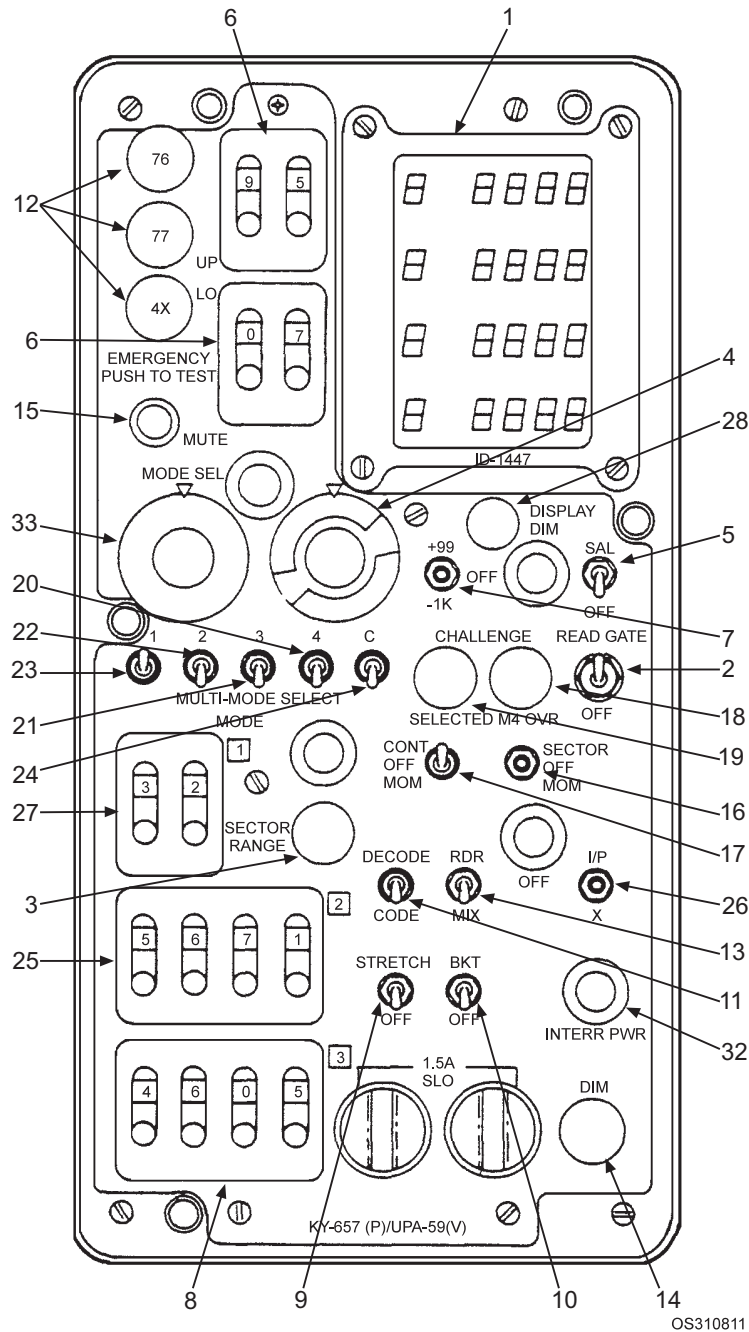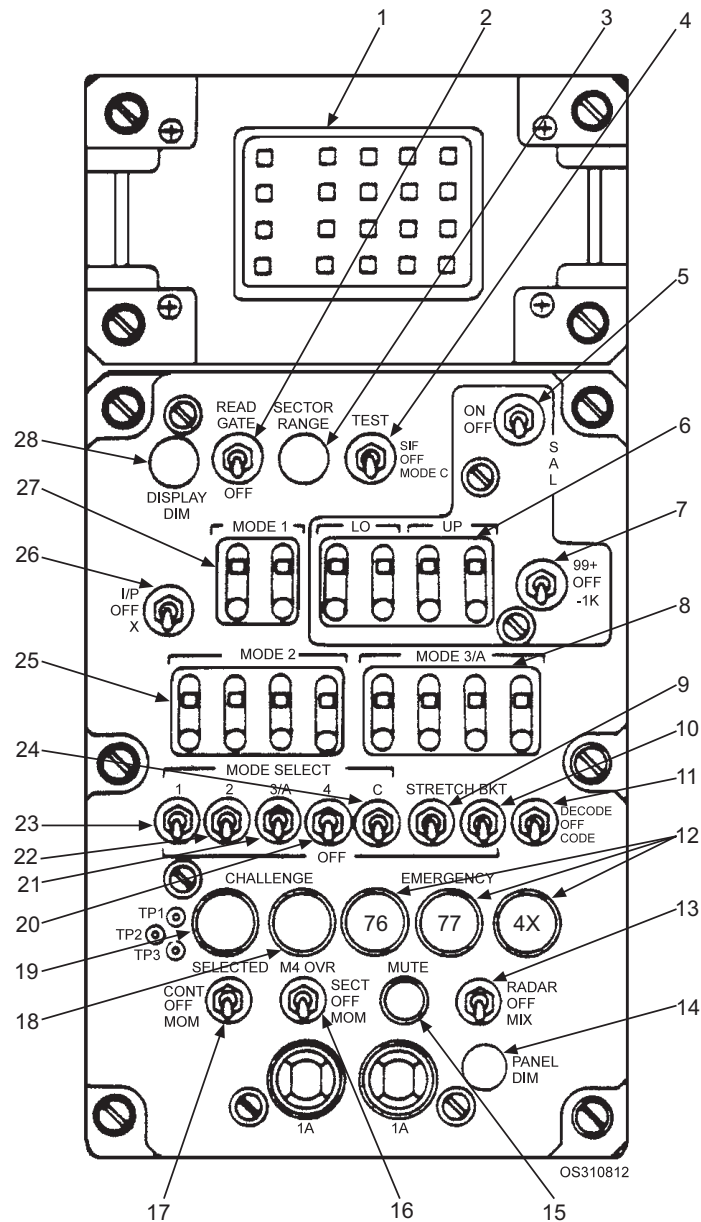
ON

POWER
DISABLE

OFF

POWER
DISABLE
SWITCH
1S4

A. VIDEO DECODER KY-657 (P) /UPA-59 (V)

ON

POWER

OFF   SPARES

IS35 POWER DISABLE SWITCH

B. VIDEO DECODER KY-761 (P) /UPA-59A
AND KY-761A (P) /UPA-59A

OS310810

Figure 8-10.—Video decoder power disable switch locations.

Figure 8-11.—Decoder AN/UPA-59 controls and indicators (front).

1. Intertarget data indicator	11. DECODE/OFF/CODE switch	21. MULTI-MODE SELECT 3/A switch
2. READ GATE/OFF switch	12. EMERGENCY 76, 77, and 4X switch-indicators	22. MULTI-MODE SELECT 2 switch
3. SECTOR RANGE control	13. RADAR/OFF/MIX switch	23. MULTI-MODE SELECT 1 switch
4. PARTY/OFF/TEST switch	14. DIM control	24. MULTI-MODE SELECT C switch
5. SAL ON/OFF switch	15. MUTE switch	25. MODE 2 code switches
6. LO switch	16. M4 OVR SECT/OFF/MOM switch	26. I/P OFF/X switches
7. SAL 99+ /OFF/-1K switch	17. SELECTED CONT/OFF/MOM switch	27. MODE 1 code switches
8. MODE 3 code switch	18. CHALLENGE M4 OVER indicator (Blue)	28. DISPLAY DIM control
9. STRETCH/OFF switch	19. CHALLENGE SELECTED indicator (Blue)	32. NTERR PWR indicator
10. BKT/OFF switch	20. MULTI-MODE SELECT 4 switch	33. MODE SEL switch

Figure 8-12.—Decoder AN/UPA-59A controls and indicators (front).

 1 Intertarget data indicator
 2. READ GATE/OFF switch
 3. SECTOR RANGE control
 4. TEST SIF/OFF/MODE C switch
 5. SAL ON/OFF switch
 6. SAL LO and SAL up switches
 7. SAL 99+/OFF/-1K switch
 8. MODE 3/A code switches
 9. STRETCH/OFF switch
10 BKT/OFF switch
11. DECODE/OFF/CODE switch
12. EMERGEMCY 76, 77, and 4X switch-indicator
13. RADAR/OFF/MIX switch
14. PANEL DIM control

15. MUTE switch
16. M4 OVR SECT/OFF/MOM switch
17. SELECTED CONT/OFF/MOM switch
18. CHALLENGE M4 OVER indicator (Blue)
19. CHALLENGE SELECTED indicator (Blue
20. MODE SELECT 4 switch
21. MODE SELECT 3/A switch
22. MODE SELECT 2 switch
23. MODE SELECT 1 switch
24. MODE SELECT C switch
25. MODE 2 code switches
26. I/P OFF/X switch
27. MODE 1 code switches
28. DISPLAY DIM control

SECTOR RANGE ADJUSTABLE
FROM 1 TO 20 MILES

OS310813

TARGET SECTOR GATE

Figure 8-13.—Sector gate range.

Mode Select Switches.—MODE SELECT switches (23, 22, 21, 20, 24 on the AN/UPA-59A or B) or MODE SEL (33) and MULTI-MODE SELECT switches (20, 21, 22, 23, 24 on the AN/UPA-59) are used to select the desired modes of interrogation. These switches designate the mode(s) that will be challenged when the SELECTED challenge switch is operated.

On the AN/UPA-59, MODE SEL (33), is used to select single mode 1, 2, 3, and C challenges; dual mode combinations 1/3, 1/C, 2/3, 2/C, and 3/C; or MULTI MODE.

In the MULTI-MODE position of the MODE SEL switch, mode selections are made in the same manner as on the AN/UPA-59A and B decoders. That is, the individual MULTI-MODE SELECT switches are used to select the mode or modes to be challenged. In MULTI-MODE, the interrogations will be interlaced according to a preset pulse count selected at the interrogator front panel. For example, with a pulse count of four and modes 1 and 3/A selected, the challenge sequence will be 1111333311113333, and so forth. The code reply coming from a commercial aircraft (mode 1 lacking) challenged by such a sequence will appear as depicted in figure 8-14, view A. Gaps during which no replies were received would be normal. For the average search radar, with its relatively slow rotation rate, the associated interrogator might receive from 30 to 40 individual replies from a single transponder during one sweep of the interrogating antenna.

For mode 4 challenging, the operator will use the M4 OVR SECT/OFF/MOM switch (16) with all three models of decoder. In the SECTOR position, the M4 OVR switch (16) will challenge all targets (in mode 4 only) within the azimuth sector covered by the active area gate. The selected interrogator cannot challenge SIF modes for the duration of a mode 4 override. In the MOM position, all targets are challenged in mode 4 only as long as the switch is held in the momentary position. Valid mode 4 replies are displayed as a single slash on the PPI displays (See figure 8-15). A mode 4 target wider than 0.5 ps or brighter than other mode 4 or bracket decode (discussed later) targets should be considered invalid. Short-range mode 4 targets should not be displayed at the periphery of the PPI, so that the target width can be inspected.

The MULTI-MODE SELECT (UPA-59) and MODE SELECT (UPA-59A/B) mode 4 switches should be used only for off-the-air testing and are not authorized for mode 4 challenging except under emergency conditions. The decoder will display targets only in those modes selected at its own front panel, although the associated interrogator may be challenging in other modes also.

NOTE

The M4 OVR sector function is not range gated; therefore, the mode 4 challenge will occur in the entire azimuth sector regardless of range.

RDR/OFF/MIX switch (13). This switch is a three-position toggle switch. In the RDR position, only radar video appears on the display. In the OFF position, only IFF video appears on the display. In the MIX position, both radar and IFF video will be displayed.

DECODER PASSIVE OPERATION AND DISPLAYS

Recall from our earlier discussion that the fundamental IFF display is the code display. With the DECODE/OFF/CODE switch (11) in the CODE position, code video will be present. This includes all incoming IFF video (raw video) for any selected mode. See figure 8-14. See tables 8-1 and 8-2 for variations in switch settings for raw video display.

NOTE

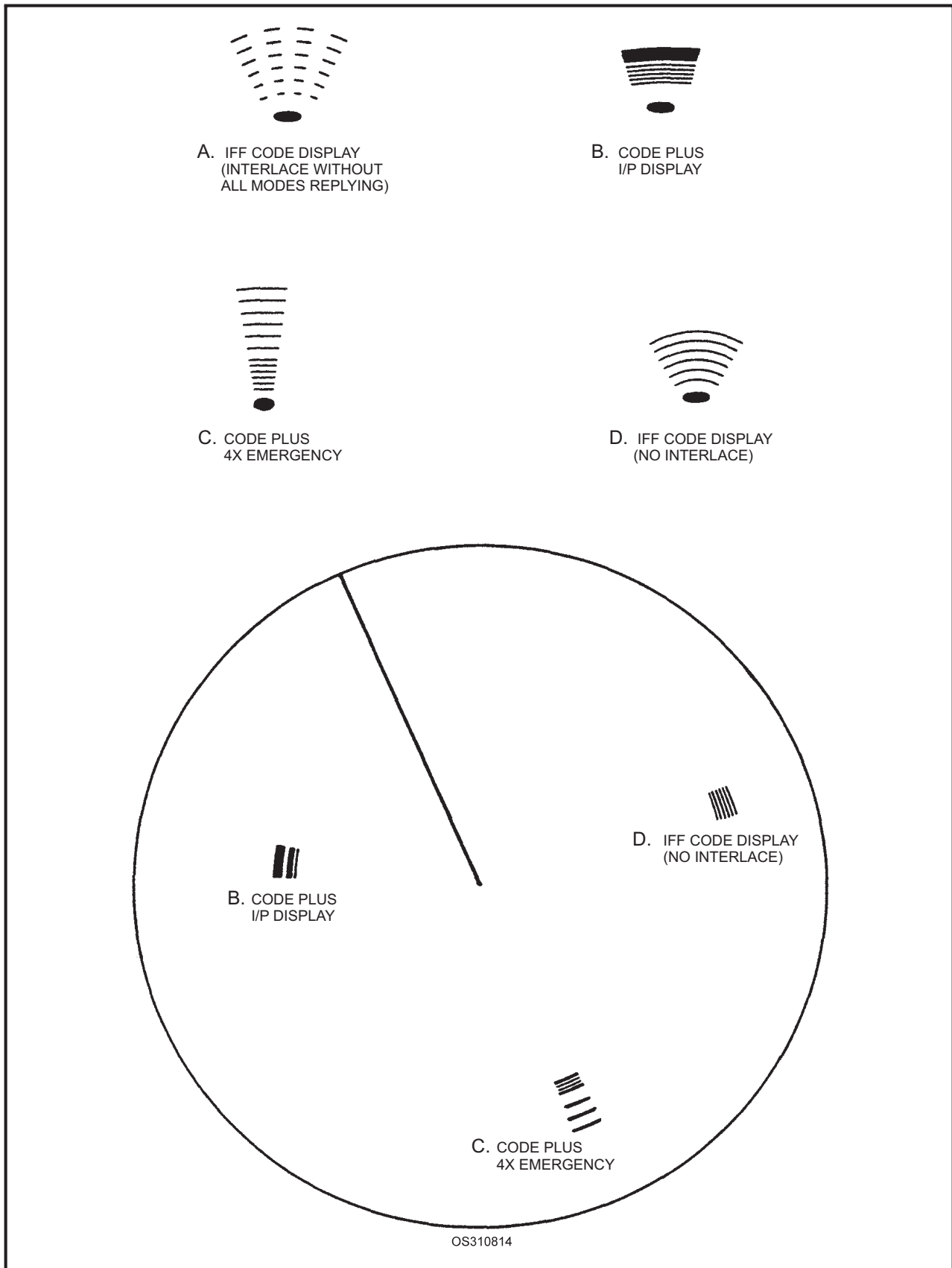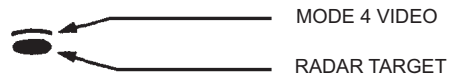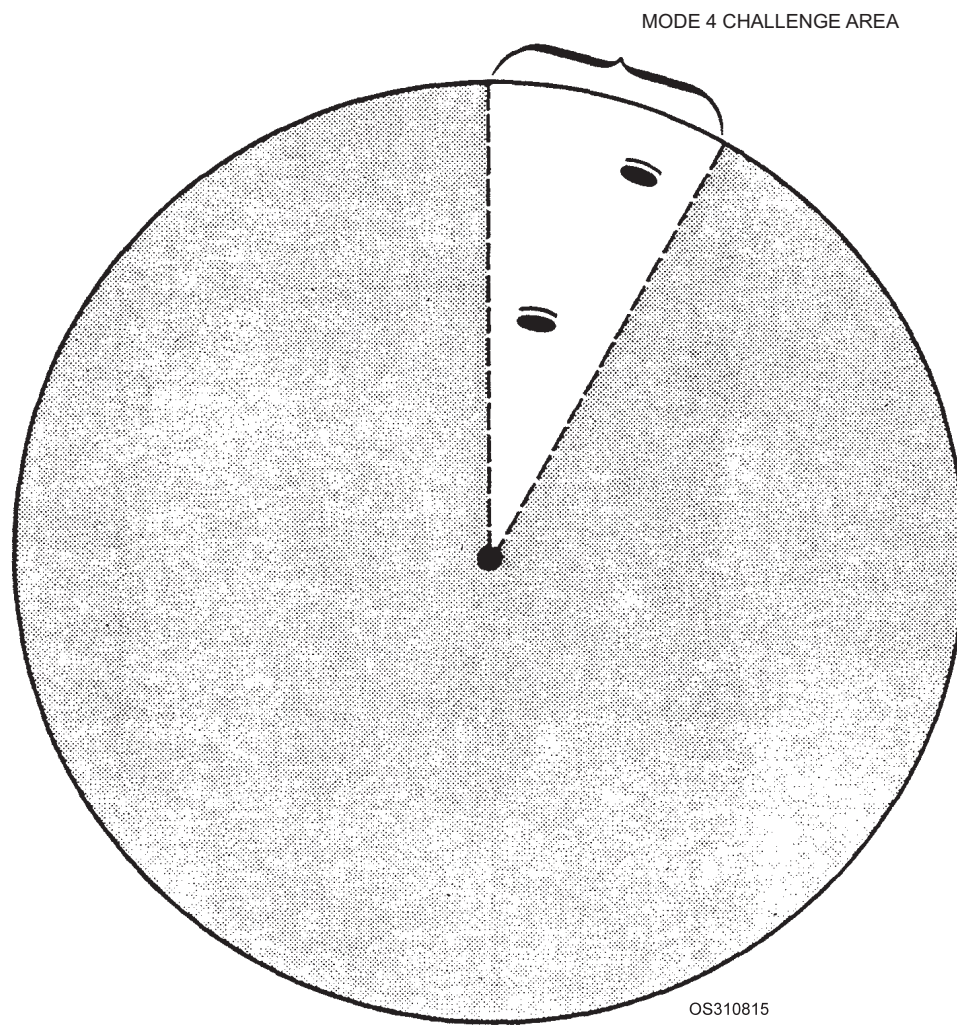Code (raw IFF) video is the only means of displaying IFF replies from a basic Mark X transponder system.

A. IFF CODE DISPLAY
     (INTERLACE WITHOUT
     ALL MODES REPLYING)

B. CODE PLUS
     I/P DISPLAY

C. CODE PLUS
     4X EMERGENCY

D. IFF CODE DISPLAY
     (NO INTERLACE)

D. IFF CODE DISPLAY
     (NO INTERLACE)

B. CODE PLUS
     I/P DISPLAY

C. CODE PLUS
     4X EMERGENCY

OS310814

**Figure 8-14.—PPI showing three different code replies: code plus l/P, IFF code,
code plus 4X emergency.**

MODE 4 VIDEO

RADAR TARGET

A. MODE 4 REPLY

MODE 4 CHALLENGE AREA

OS310815

B. MODE 4 REPLIES PPI DISPLAY

Figure 8-15.—Mode 4 replies.

Whatever its presentation format (code, decode, bracket decode, stretched video, etc.), IFF video is timed to display after radar video for the same target. The amount of this "range offset" will be determined by a number of factors. The range offset for mode 4 is always half of what it is for the other modes. The following offsets (in nautical miles) are typical.

	SIF and Mod C	Mode 4
Air Search Radars	2	1
Surface Search Radars	1	0.5
Fire Control Radars	0.5	0.25

You may choose the passive decode (no display the IFF codes) function for modes 1, 2, and 3JA operation by setting the DECODE/OFF/CODE switch (11) to DECODE. This provides a 1.0 µs single-pulse output for each mode 1, 2, or 3/A target reply, only if the reply code matches the associated MODE code switch (27) (25) (8) settings on the decoder front panel. If you need to make the code video for a specific aircraft stand out from the other video, you can stretch the passive decode pulse to 10 µs (fig. 8-16) by setting the STRETCH/OFF switch (9) to STRETCH (See figure 8-17). Mode C replies represent altitude and are not passively decoded. For certain target overlap (garbled) conditions, you may inhibit the passive decode function to keep it from being displayed.

For moderately garbled targets, you can use the active-decoding feature to extract the reply codes of targets of interest. For severely garbled targets displayed by active decoders or moderately garbled targets at passive decoders, you can manually decode IFF replies (if the PPI has an OFF-CENTER control). By alternating between the OFF-CENTER and RANGE adjustments on the display, with CODE and

one mode at a time selected at the video decoder, you can display the individual reply pulses.

NOTE

If you desire to see passive decoding of only the first two digits of the reply train, set the 12P/6P switch (rear panel of decoder) to the 6P position. For example, with 6P selected and the first two digits of the associated MODE code switches set to 64, all codes beginning with 64 will be decoded. This will happen, regardless of the value of the last two digits of the reply code or the last two digits set into the associated MODE code switches. With the 12P position selected and mode 1 enabled, only replies having a first digit 0 through 7, a second 0 through 3, and the last two digits 00 may provide passive decodes. Other codes are invalid for mode 1 and result from fruit replies in other modes. However, the requirement that the last two digits be 00 is removed for mode 1 with 6P selected. If you select the 12P position with mode 2 or 3/A enabled, all four digits of the replies will be decoded.

You may want to use the bracket decode operation for modes 1, 2, 3/A, and C. The bracket decode is a check for the occurrence of the bracket (f_1 and f_2) pulses, which frame all IFF reply code trains for the SIF modes and mode C. Positioning the BKT/OFF switch (UPA-59, UPA-59A) or BKT/OFF/ALL (UPA-59B) switch (10) to BKT will provide a single 0.4 µs pulse for all SIF and mode C replies, regardless of code content. See figures 8-18 and 8-19. In the ALL position, decoded bracket pulses for all modes being challenged by the selected interrogator will be displayed, rather than just those modes selected at that AN/UPA-59B decoder position. For certain target overlap (garbled) conditions, the bracket decode may be inhibited and not displayed.
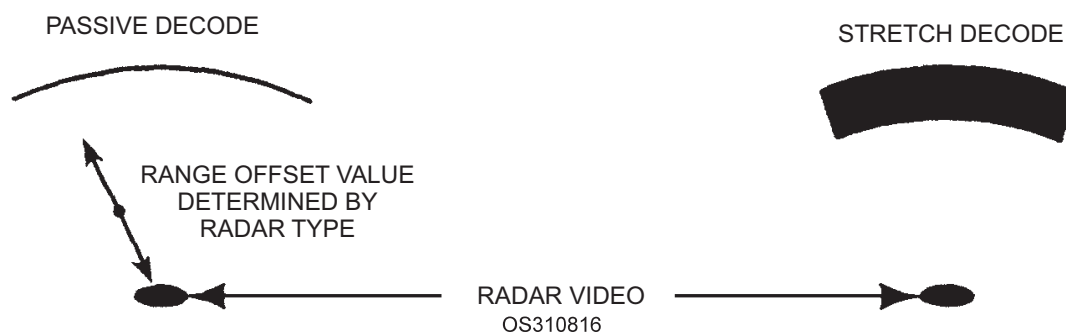

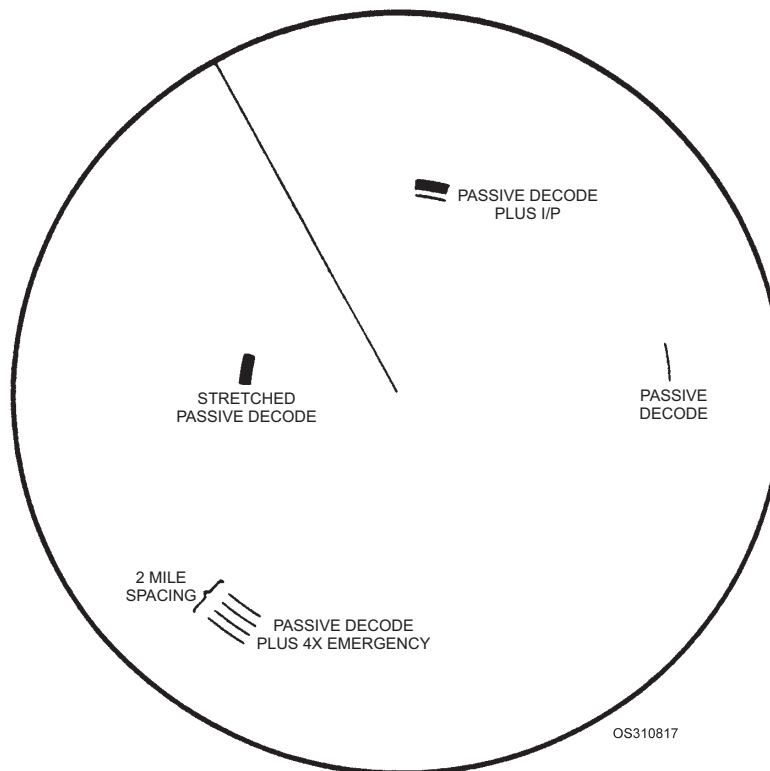**Figure 8-16.—Passive decode and stretch decode displays.**

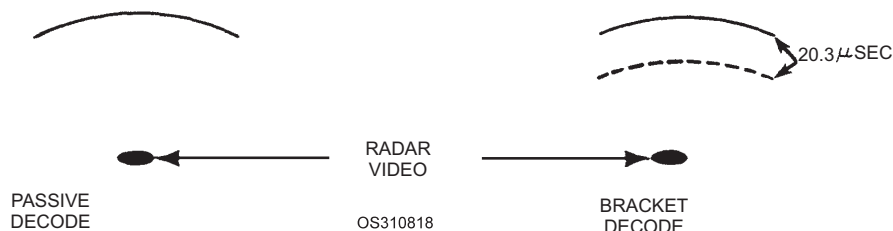**Figure 8-17.—Passive decode displays.**

Figure 8-18.—Example showing bracket decode.

Stretched passive decoding with bracket decoding is used for displaying all valid SIF targets. This format provides a stretched pulse for replies matching the mode code switch settings and a single pulse for all other valid replies. The AN/UPA-59 and AN/UPA-59A BKT/OFF switch or the AN/UPA-59B BKT/OFF/ALL switch is positioned to BKT and the STRETCH/OFF switch to STRETCH for this feature. Figure 8-19 shows a bracket decode target and a stretched passive decode target. Mode C replies, if selected, can only be displayed as bracket decode pulses and are not stretched.

The I/P decode function is useful for identifying, on the PPI display, a particular target with which you have voice communications. Position the I/P/OFF/X switch (26) (fig.8-12) to I/P when you request an aircraft or vessel to identify its position. Refer to table 8-3 for appropriate IFF brevity codes for voice communication. This display format provides a single 20 μs stretched pulse (following each code, passive decode, or bracket decode reply as selected) for each target that is replying with the I/P code. The operator of the transponder to be challenged must manually enable I/P replies. If you select I/P, the IDENT pulse will be displayed only if one or more SIF modes are enabled. An I/P decode display will be presented to the PPI in all three positions of the DECODE/OFF/CODE switch. Refer to figures 8-14, 8-17, and 8-20 for typical I/P displays.
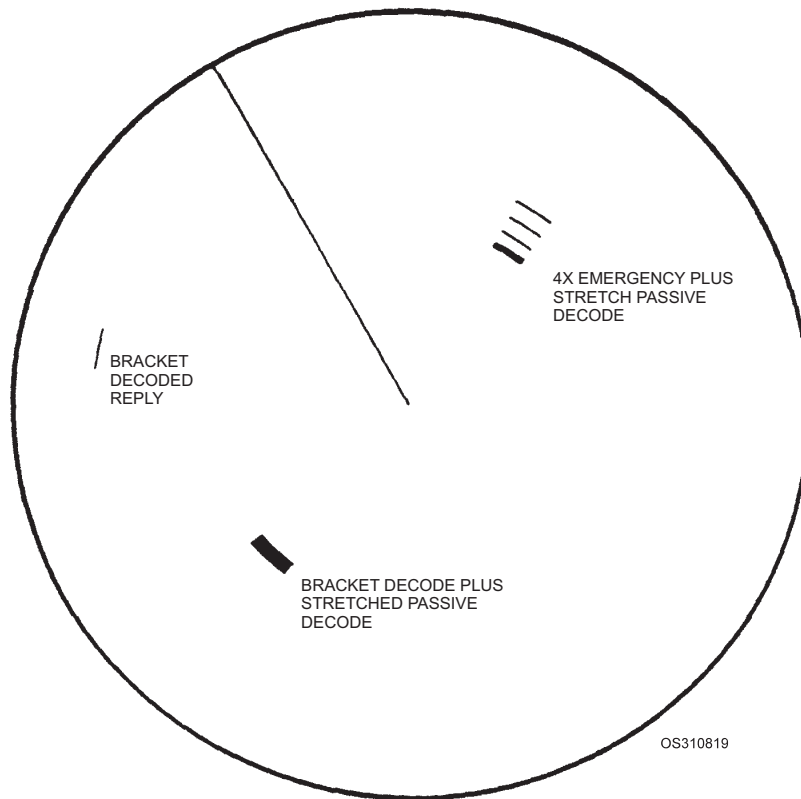
Figure 8-19.—Stretched passive decode with bracket decode.

Table 8-3.—IFF/SIF Brevity Codes

CODE	MEANING
PARROT	Military IFF/SIF transponder.
SQUAWK(ING)	Operate IFF/SIF transponder as indicated, or IFF/SIF transponder is operating as indicated.
SQUAWK ONE ( )	Turn IFF MODE 1 switch on and mode 1 code control dials to the designated setting.
SQUAWK TWO ( )	Turn IFF MODE 2 switch on and mode 2 code control dials to the designated setting.
SQUAWK THREE ( )	Turn IFF MODE 3 switch on and mode 3 code control dials to the designated setting.
SQUAWK MAYDAY	Turn IFF MASTER switch to EMERGENCY.
SQUAWK IDENT	Depress I/P switch. (Note I/P switch is spring loaded.)
SQUAWK MIKE	Turn I/P switch to MIC position. Make a short radio transmission.
SQUAWK LOW	Turn IFF MASTER switch to LOW position.
SQUAWK NORMAL	Turn IFF MASTER switch to NORM position.

CODE PLUS
I/P DISPLAY

PASSIVE DECODE
PLUS I/P

OS310820

Figure 8-20.—Example showing the I/P reply trains.

NOTE

In some older transponder sets, mode C replies from 30,800 feet to 94,700 feet (inclusive) may include a special position indicator (SPI) pulse. These will decode as an I/P reply if mode C is enabled. Thus, you should disable mode C whenever you are requesting an I/P reply.

The X-pulse decode format provides a single display pulse for all reply codes that contain both an X-pulse and a good code match with the associated mode's code switch settings. X-pulse replies are transmitted only from pilotless aircraft and are not present for mode C. You must know the reply code of a pilotless aircraft before you can display the reply using X-pulse decoding. X-pulse decode displays are identical to the passive decode displays of figure 8-17. To activate X-pulse decoding, position the I/P/OFF/X switch (26) to X and set the code in the selected mode's code window (27, 25, or 8). See figure 8-12.

The stretched X-pulse decode plus bracket decode provides a single pulse for all targets with bracket replies (including mode C) and a stretched pulse for targets that meet the passive decode with X-pulse requirements. The required switch settings are the BKT/OFF switch (UPA-S9/59A) or BKT/OFF/ALL switch (UPA-59B) set to BKT, the I/P/OFF/X switch set to X, and the desired codeset in the selected mode's code window. See figure 8-17 for the stretched passive decode display.

NOTE

Continue to use the numbers in parentheses to refer to the AN/UPA-59 front panel (fig. 8-11) and the AN/UPA-59A and AN/UPA-59B front panel (fig.8-12).

EMERGENCY DISPLAYS

The decoder also provides special displays to the PPI for emergency replies. In addition to video displays, when a preset number of emergency replies are received within a certain period of time, the visual

and audible emergency alarms sound. When the audible alarm sounds, you can disable it by using the momentary MUTE switch (15). The alarm MUTE function is internally adjustable for a 2- to 10-second period, but the switch is usually set to 10 seconds.

When the decoder has sounded an emergency alarm, you can rapidly identify the target with the emergency by setting the DECODE/OFF/CODE switch to OFF, the BKT/OFF switch to OFF, and the I/P/OFF/X switch to OFF. With this arrangement, only emergency reply decodes will be displayed on the indicator. (Emergency reply decodes are processed by the decoder, regardless of switch settings, as long as IFF video is selected and the decoder is enabled for the mode(s) in which the emergency replies are occurring.)

The following paragraphs describe the various types of emergencies decoded and the indications the decoder provides for each type of emergency.

4X Emergency

A 4X (military only) emergency reply decodes as four pulses approximately 2 miles apart. (The 4X emergency display will be superimposed on the code display if you have selected CODE.) Only mode 1, 2, and 3/A replies may be augmented with the 4X emergency code, but this type of reply can be decoded when SIF modes are being interlaced with modes C and 4. Figures 8-14, 8-17, 8-19, 8-21, and 8-22 show 4X emergency displays; table 8-1 gives the required switch settings for this display. When the decoder detects a preset number of 4X emergency replies within a specified period of time, the 4X emergency alarm function will activate, causing the 4X indicator light on the decoder front panel to flash. The audible alarm and 4X light (12) will energize also on the alarm monitor, if installed. The 4X emergency function remains activated for 1 second after the emergency condition has ended.

7600 Emergency

The 7600 emergency reply generates three pulses approximately 1 mile apart for the display. Reply code 7600 in mode 3/A only is designated a 7600 emergency (7600 replies to modes 1 and 2 are not emergency replies). The 7600 emergency signifies a radio communication failure and can be decoded if other modes are being interlaced with mode 3/A. Table 8-1 shows the switch settings for 7600 emergency decoding. Figures 8-22 and 8-23 show the display. The
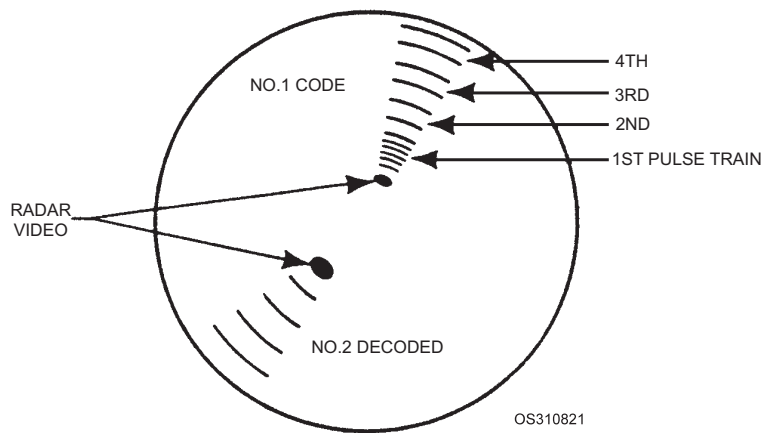
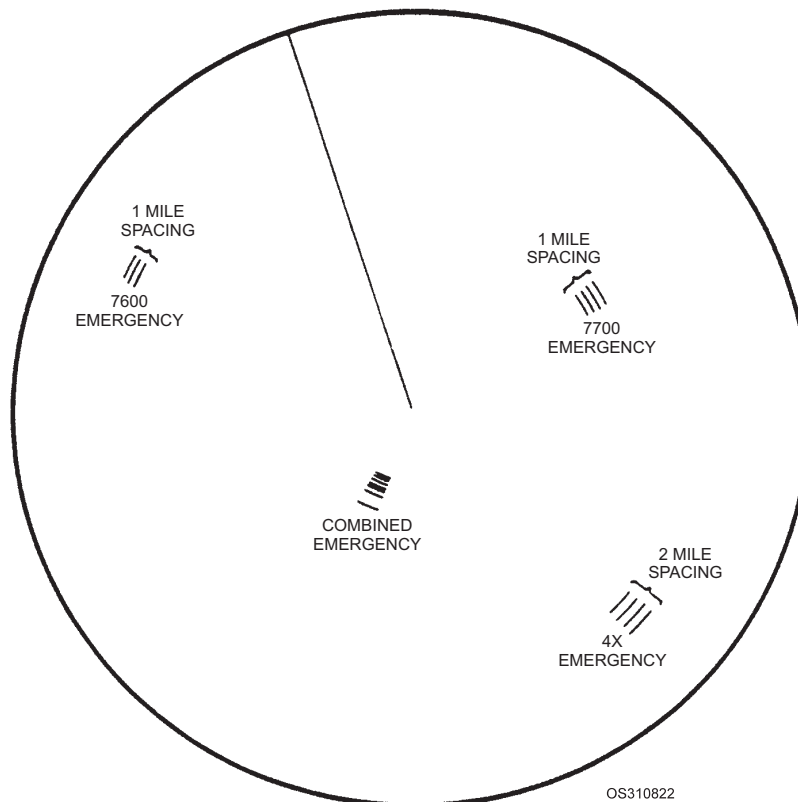**Figure 8-21.—Coded and decoded 4X emergency reply.**

Figure 8-22.—Emergency replies.

emergency display will be superimposed on the code display if you have selected CODE. When the decoder detects a preset number of 7600 emergency replies within a specified period of time, the 7600 emergency alarm function will activate, causing the 76 indicator light (12) on the decoder front panel to flash. The audible alarm and 76 light will energize also on the alarm monitor, if installed. The 7600 emergency function remains activated for 1 second after the emergency condition has ended.

7700 Emergency

The 7700 emergency reply generates four pulses approximately 1 mile apart for the display. Only mode 3/A, code 7700 replies are designated 7700 emergencies, but this type of emergency can be decoded if other modes are being interlaced with mode 3/A. The 7700 reply for mode 3/A is a civilian emergency reply (military emergencies for mode 3/A combine the 7700 reply and the 4X reply). Table 8-1 shows the switch settings for 7700 emergency decoding. Figures 8-22 and 8-24 show the display. The
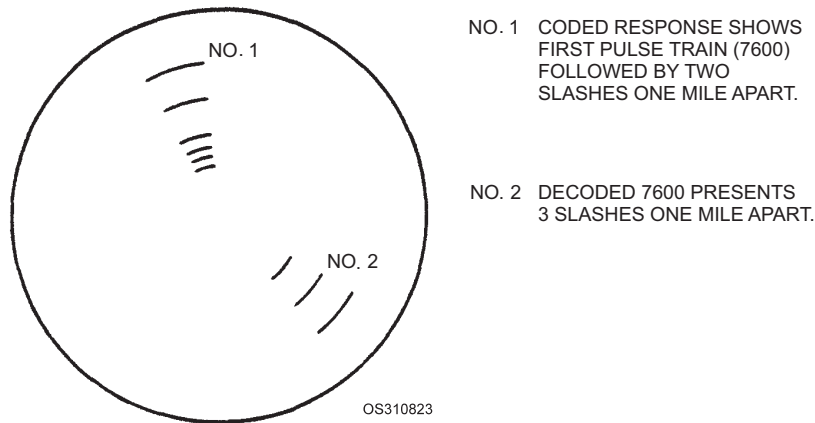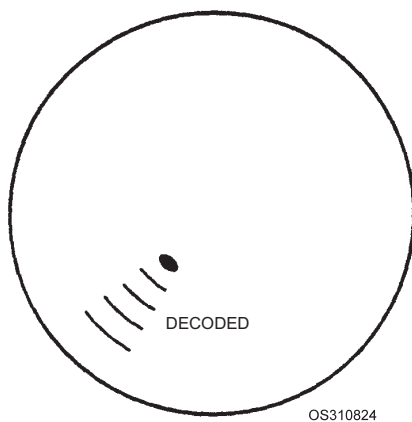
8-26

NO. 1 CODED RESPONSE SHOWS
FIRST PULSE TRAIN (7600)
FOLLOWED BY TWO
SLASHES ONE MILE APART.

NO. 2 DECODED 7600 PRESENTS
3 SLASHES ONE MILE APART.

OS310823

Figure 8-23.—Two examples of a 7600 emergency reply.

DECODED

OS310824

Figure 8-24.—Decoded reply of a 7700 emergency.

DECODED 4X AND 7700
EMERGENCY COMBINED

OS310825

Figure 8-25.—Combined emergency.

emergency display will be superimposed on the code display if you have selected CODE. After a preset number of 7700 emergency replies are detected by the decoder within a specified period of time, the 7700 emergency alarm function will be activated, causing the 77 indicator light (12) on the decoder front panel to flash. The audible alarm and 77 light will also energize on the alarm monitor, if installed. The 7700 emergency function remains activated for 1 second after the emergency condition has ended.

Combined Emergency

A combined emergency reply is transmitted by military transponders in mode 3/A. It is a combination of the 4X and 7700 reply codes. Table 8-1 gives the required switch settings for this type of display, which consists of the 7700 and 4X emergency displays superimposed (7 additional pulses). The combined emergency reply can be decoded when other modes are being interlaced with mode 3/A. Figures 8-21 and 8-25 show examples of the combined emergency display.

After a preset number of combined emergencies are decoded within a specified period of time, the combined emergency function is activated. The combined emergency function causes the 77 and 4X lights (12) on the decoder and the alarm monitor (if installed) to flash simultaneously. It also causes the alarm monitor to produce the combined tones of the 7700 and 4X emergencies. The combined emergency function remains activated for 8 seconds after the emergency condition has ended.

SELECTED ALTITUDE LAYER DECODING (SAL)

If you wish to highlight aircraft flying at a specific altitude or within a specific altitude band, use the *selected altitude layer (SAL)* decoding feature. SAL decoding allows you to specify the altitude(s) by placing settings on the UP and LO switches (6).

The SAL function operates very differently in the AN/UPA-59, AN/UPA-59A, and AN/UPA-59B decoders. To decode mode C targets, the AN/UPA-59

passive decoder must be operated in SAL bracket or SAL parity decode (discussed below). The operation of the AN/UPA-59A and AN/UPA-59B has been simplified to just a SAL decode. In SAL bracket decode, the AN/UPA-59 will not decode or display code video for other modes (this constitutes a SAL override of SIF). Table 8-1 gives the required switch settings for the SAL bracket decode and SAL decode displays. For the (V)1 configuration, the SAL bracket or SAL decode display is an effective means of determining the altitude of a target, since no active readouts are available. By varying the settings of the UP and LO switches and checking for the presence of the SAL bracket on the display, you can determine the altitude of a target to a 100-foot accuracy. You can use the "99+/OFF/-1K" switch (7) to override the lower and upper limits of SAL. When this switch is in the -1K position, the SAL is from $-1,000$ feet to the limit set by the UP switch. In the 99 + position, the SAL is from the LO switch setting to 126,700 feet.

MODE 4 OVERRIDE DISPLAYS

Initiating a mode 4 override from any decoder position interrupts all challenging except mode 4 for the duration of the over-ride condition. Mode 4 multi-mode operation, on the other hand, allows other modes to be interlaced with mode 4, thereby maintaining IFF video presentation to decoder positions selecting other modes. During a mode 4 override, no decoder position selecting the overridden interrogator system can present any IFF video except mode 4. Current operating policy prescribes that except under emergency conditions, mode 4 will be used in the over-ride manner. Continuous interrogation in mode 4 is prohibited because this would interfere with the routine display of targets in other modes. Once a target has been confirmed as friendly through mode 4, there is no need to re-interrogate it in mode 4 unless the track has been broken. An unknown may be interrogated several times in mode 4 and an assumed hostile should be challenged at least twice, once upon detection and again before weapons release. The two types of mode 4 override operation are described in the following paragraphs. As shown in table 8-1, you initiate a mode 4 override at the M4 OVR-SECTOR/OFF/MOM switch on the decoder front panel. This switch operates independently of other front panel switch settings.

Mode 4 Sector Override ((V)2 only)

This method of operation will display all selected modes (excluding mode 4) except during the gated sector (active area azimuth), when mode 4 alone is displayed. During the time the sweep passes through the sector, mode 4 video is displayed over the total display range, not just in the range of sector. Refer to figure 8-26. Table 8-1 gives the switch settings for this type of operation. For conventional indicator displays, the azimuth width covered by the sector remains constant as the active area is changed in position. However, for NTDS displays the azimuth width of the sector varies as the active area gate is moved in range. Mode 4 sector override operation is effective with the decoder READ GATE switch in any position. With the SELECTED switch set OFF, only mode 4 (and the sector gate) will be displayed during the sector, and no video will occur elsewhere.

Mode 4 Momentary Override

This format displays mode 4 video when the M4 OVR switch is held in the MOM position. During this time, only mode 4 is challenged by the selected interrogator. Table 8-1 gives the required switch settings for mode 4 momentary override operation. When the M4 OVR switch is released to the OFF position, challenging returns to the format determined by the mode select switches.

ACTIVE DECODING ((V) 2 CONFIGURATION ONLY)

The active decoding function of the decoder is independent of the passive decoding functions we discussed in the preceding sections. The purpose of the active readout circuitry is to provide a digital display of selected target codes and altitudes. As we explain later in this section, targets are selected for active decoding on the indicator by placing an active area window over them. The active target's code and altitude readouts are presented on the intra-target data indicator.

Active readouts are initiated as the indicator sweep passes through the active area on the display. The intra-target data indicator channels, which read out the individual codes, hold the code display (remain lighted) for a period of time adjustable by an internal control. This readout time is usually set so the channel readouts are reset (turned off) just before the sweep completes one rotation and starts through the active area again. Thus the allowable readout time depends on
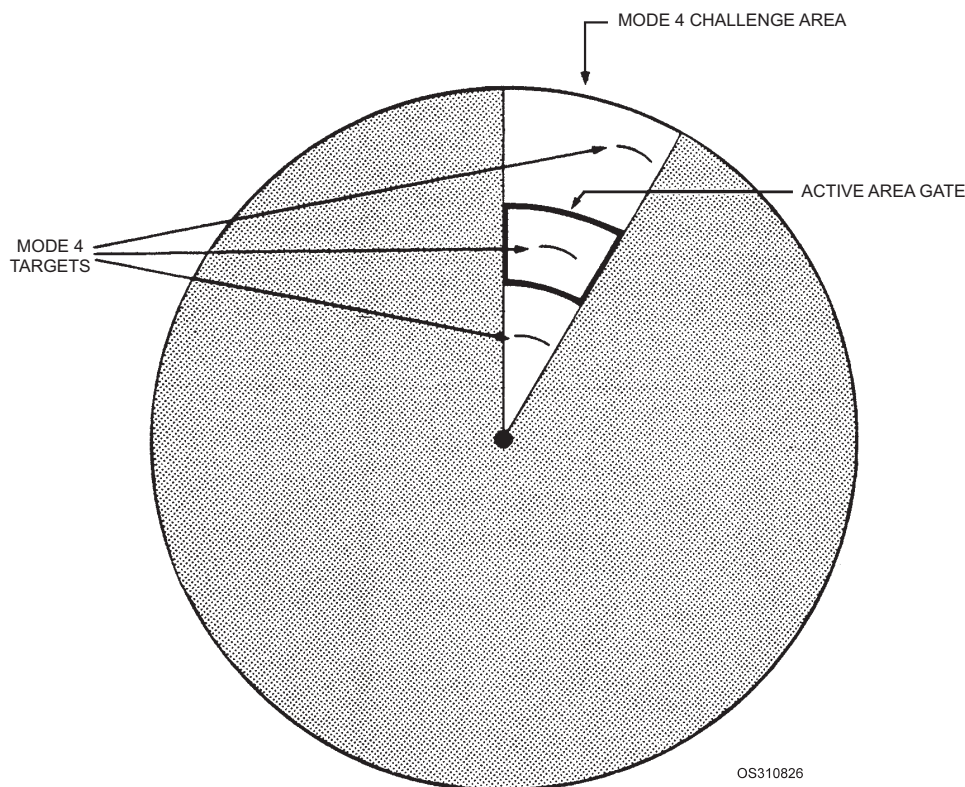
Figure 8-26.—Mode 4 video display (sector override).

antenna rpm, with lower rpm's allowing longer readout times.

NOTE

The AN/UPA-59B can reset the intra-target data indicator for every revolution of the antenna. If this feature is used, the readout display time will be directly related to antenna rpm and not internal adjustment. This feature is required when antenna rpm exceeds 20 rpm.

The active area presentation on a PPI will differ between conventional indicators and NTDS consoles. Operating requirements will also differ. A conventional indicator's active area is supplied to the indicator display by the decoder, having been developed from range strobe and azimuth data provided by the indicator. The conventional active area is developed in range and azimuth coordinates and is shown in figure 8-27. The NTDS active area, however, is supplied to the decoder by the NTDS console in the form of gating information. It is developed in X-Y coordinates and appears as in figure 8-28. (There are several internal link adjustments for the decoder which are set up at installation to allow operation with one or the other type of indicator.)

For conventional indicator presentations, you can adjust the range (length) of the active area gate from approximately 1 to 20 miles with the SECTOR RANGE potentiometer (#3 in figures 8-11 and 8-12) on the decoder front panel. See figure 8-13. Azimuth (width) adjustment is provided by an internal control. To cover the selected target(s) adequately, set the active area for conventional displays to the minimum range necessary. For decoders at NTDS consoles, set the SECTOR RANGE potentiometer to the minimum setting (full counter-clockwise), permitting the NTDS console gate-size controls to determine the size of the active area. Increasing the SECTOR RANGE control on decoders at NTDS positions would extend the active-area range, and the NTDS console controls would no longer be effective.

You can position the active area on conventional displays by using either the cursor bearing and range strobe controls or by using the "joystick" control. The bearing and range indicators on the associated PPI then depict the approximate position of the active area. The active area for conventional indicators covers a constant range length and azimuth width as its position is varied on the indicator. For NTDS consoles, however, the azimuth width covered by the active area varies with its position in the range dimension because
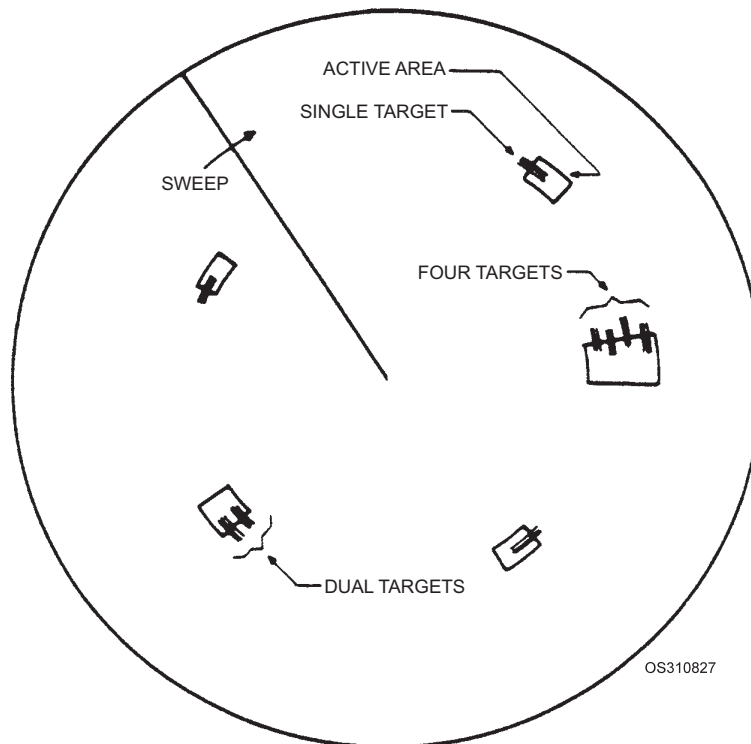
NOTE: ONLY ONE ACTIVE AREA WILL BE PRESENT AT ANY ONE TIME ON
THE INDICATOR.

Figure 8-27.—Active area placement on conventional indicator.
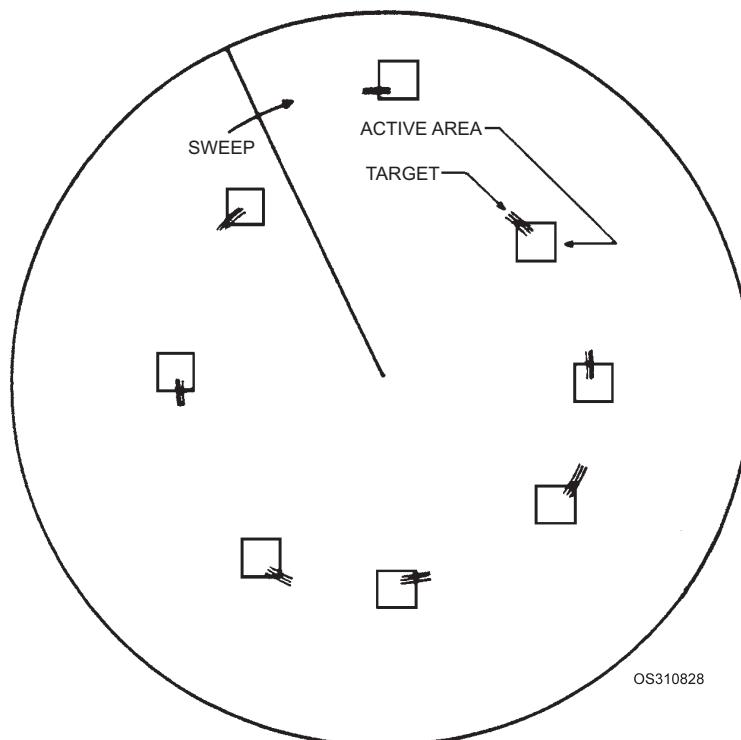
NOTE: ONLY ONE ACTIVE AREA WILL BE PRESENT AT ANY ONE TIME ON
THE INDICATOR.

Figure 8-28.—Active area placement on NTDS indicator.

the lengths of the sides remain constant in miles. Position the active area on the NTDS display with the ball tab control on the NTDS console.

For both types of PPI, the decoder READ GATE switch (#2 in figures 8-11 and 8-12) generates an outline of the active area for presentation on the display. The switch also enables the active readout circuitry in the decoder.

For NTDS active decoding, it is good practice to place only one target in the active area at a time. When multiple targets are included, it is difficult to range correlate the readouts with the corresponding targets. However, conventional displays may include multiple targets, as we discuss in the following paragraphs.

The setting of the decoder MODE SEL switch (AN/UPA-59 only) selects one of three types of programming for the channels in the intra-target data indicator as follows:

SINGLE MODE—When the active decoder is operated in single mode (except by MULTI-MODE selection), each of the four channels is programmed to read out data for the selected mode. Thus, for conventional displays where multiple targets may be processed simultaneously, up to four targets may be read out for the selected mode if they are adequately

circumscribed by the active area. If all targets in the active area are intersected by the leading edge of the area gate, the target readouts will occur in range order from the top to the bottom of the indicator. See figure 8-29, view A. If fewer than four targets are being decoded, the remaining channels remain unlighted.

DUAL MODES—When dual modes are selected (1/3, 3/C, etc.), the first and third channels from the top of the intra-target data indicator are programmed to read out data from the first mode, and the second and fourth channels are programmed to read out data from the remaining mode. Thus, data from one or two targets may be read out. See figure 8-29, view B. (NTDS should be limited to one target in this case.). If the leading edge of the area gate is bisecting two targets and if each target is replying in both of the selected modes, the upper two channels will read data from the target at short range, and the lower two channels will read out data from the target at long range. If two targets are displayed in the area gate but only three channels of data appear on the active decoder, you cannot rely on code association with the corresponding target. The occurrence of a blank channel means that one of the targets replied in only one mode and the single readout for the missing mode is not necessarily ordered properly in range.
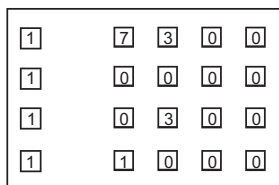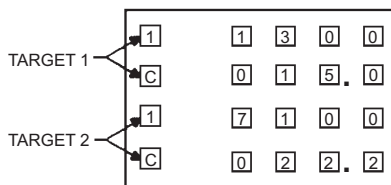

A. SINGLE MODE 4 TARGETS
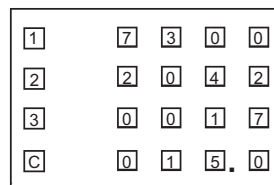
C. MULTI MODE OPERATION
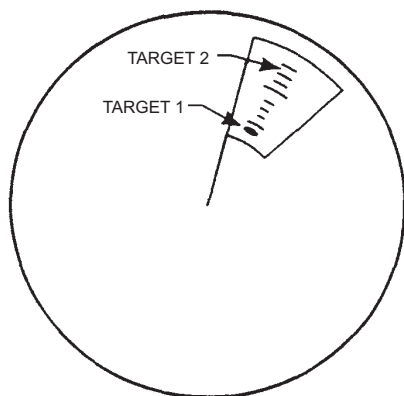
B. DUAL MODE OPERATION

OS310829

Figure 8-29.—Examples of intra-target data indicator displays.

MULTI-MODE—When the MULTI-MODE position of the MODE SEL switch is selected, the four channels of the active readout are each programmed to read one particular mode. (See figure 8-29, view C). The top channel displays only mode 1 data, the second only mode 2 data, the third only mode 3/A data, and the bottom channel only mode C data. If any modes are not enabled or if a selected target is not replying to a particular mode, the channels for these modes will remain unlighted. For multi-mode operation (conventional or NTDS displays) only one target should be actively decoded at a time. If you attempt active decoding for more than one target in multi-mode operation, you will find it impossible to associate the readouts with the proper target.

The setting of the MODE SELECT switches for AN/UPA-59A and B decoders selects one of three types of programming (single, dual, or multi-mode) for the channels in the intra-target data indicator. The readout is essentially the same as described above for single mode, dual mode, and multi-mode operation of decoder group AN/UPA-59.

Since active decoding for NTDS displays involves single targets, only the top channel will be used in single-mode operation. For dual-mode operation, only the first two channels will be used. Multi-mode operation for NTDS displays is identical to that for conventional displays.

Proper placement of the active area over targets is an important factor in maintaining the validity of the active readouts. Figure 8-27shows recommended area gate placements for targets at various positions on conventional indicators. Single targets should be bisected simultaneously by the leading edge of the area gate or else gated separately. When multiple targets are not all cut by the leading edge of the gate, even though they may be contained within the gate, the probability of an invalid readout is increased. The NTDS active area should be placed so that the target is bisected by the leading edge of the gate, as shown in figure 8-28, reducing the possibility of fruit readouts.

A correlation link is provided internally for the decoder. With correlation selected, a target reply code for a given mode must be present on two consecutive interrogations for the code to be displayed on the active readout. This further reduces interference from fruit replies.

Active degarbling occurs for all active readouts. When two replies overlap (garble condition), the active readouts will be inhibited.

Q3. *What transponder control set is used to set in modes 1 and 3/A reply codes?*

Q4. *What does a mode 4 emergency code reply look like on a radar scope?*

OPERATION UNDER JAMMING AND EMERGENCY CONDITIONS

The IFF system has several anti-jamming features and will be enhanced with more of these in the years ahead. The decoder contains special circuitry to reduce jamming caused by constant transmission of signals known as *reset tags*. Only the AN/UPA-59 decoder is susceptible to reset tag jamming, and this is being corrected with a field change entitled "P1 Reset". The interrogator set has anti-jam circuitry, which you can activate by placing the interrogator set front panel ANTI-JAM ON/OFF switch in the ON position. A field change entitled "Anti-Jam Receiver" will operate automatically and reduce more types of jamming signals. When this field change is installed, the ANTI-JAM switch will remain in the ON position. Also, a JAM indicator will be installed on Control-Monitor C-8430/UPX. Under most types of jamming, the decoder should be operated in the CODE display format for best results. However, the type of jamming that is present will determine which methods of decoder operation are reliable.

The following paragraphs describe the various emergency conditions you may encounter and the actions you must take to overcome them.

Normally, the decoder gets its primary power from the interrogator set. If something interrupts this power, you can restore power to the decoder by setting the decoder rear panel LOCAL/OFF/INTERR switch to the LOCAL position. This allows decoder primary power to be controlled at the decoder, not by the interrogator set. If there is a total power failure to the decoder group, radar video will be supplied to the PPI by means of a bypass relay.

If the decoder's remote enable lines to the interrogator set (via a switchboard, as in figure 8-1) fail, the LOCAL/REMOTE switch on the front panel of the interrogator can be set to the LOCAL position. This allows you to select modes locally by using the interrogator MODE SELECT and CHALLENGE switches. With the interrogator switched to LOCAL, the desired IFF modes must still be selected at each decoder position to enable the decoder to function properly. With LOCAL control selected at the interrogator set, the GTCLONG/SHORT switch on the

interrogator set front panel controls the receiver GTC function. Remote control of this parameter is removed from the control-monitor, C-8430/UPX.

If the enable circuits are only partially lost, the interrogator set may be enabled from any functioning decoder position. However, the desired modes must still be selected at the decoder whose enable lines failed, in order for decoded displays to be programmed properly. If control lines other than MODE SELECT and CHALLENGE SELECTED are lost, IFF presentation will be at a reduced capability (e.g., code video only) or lacking altogether (radar video only).

MODE 4 SYSTEM OPERATION

Directive instructions on the use of mode 4 are provided in ACP 160 US Supp 1(C) (chapter 1, paragraphs 102 and 104, and chapters 3 and 5), which is recommended for further reading. For units operating with NATO forces, appropriate paragraphs from chapters 1 and 2 of ACP 160 NATO Supp-l(C) apply.

Mode 4 interrogations may be enabled in either of two ways: interlacing or overriding

Mode 4 interrogation used to be enabled as part of a mode interlace sequence that would challenge mode 4 on every other change of mode. For example, if modes 1, 2, 3/A, and 4 were selected with a pulse count of 2, the challenge sequence would be 44-11-44-22-44-33-44. Interlace sequences and pulse counts are selected at the front panels of interrogators. Current policy prohibits this method of mode 4 use because of difficulties arising from continuous mode 4 interrogation (ATCRBS interference and signal security considerations). The approved switch settings for the interrogator set will disable the MODE SELECT/4 switch (20) on the decoder front panel.

Currently, all mode 4 challenging must be done using the mode 4 override function. Whenever the mode 4 override is enabled, the selected interrogator system will challenge mode 4 only, regardless of other modes that may be enabled (at any decoder linked to that interrogator system).

Mode 4 override may be selected in sector or momentary modes. A sector override operates continuously throughout the azimuth of the sector gate. See figure 8-30, view A. A momentary override operates only as long as the M4 OVR switch is depressed in the MOM position. See figure 8-30, view B. When you make MOM override interrogations,

A. SECTOR: CHALLENGED TARGETS FALL WITHIN A SECTOR DETERMINED BY WIDTH OF TARGET SECTOR GATE.

PPI DISPLAY

B. MOMENTARY: CHALLENGED AREA SHOULD NOT EXCEED 30 DEGREES OF AZIMUTH.
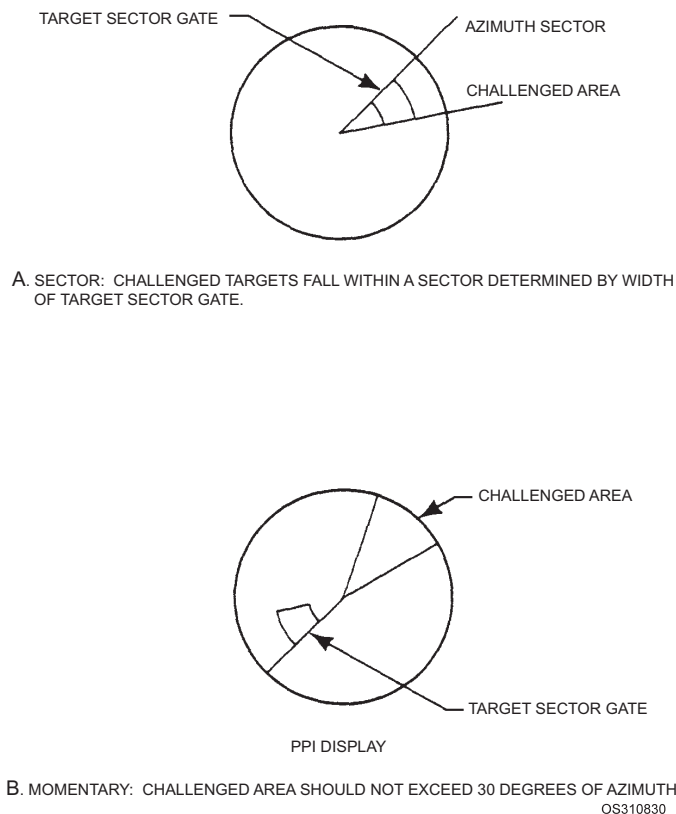
OS310830

Figure 8-30.—Example of the mode 4 override operation.

limit them to sectors of about 30 degrees for systems having slow and medium antenna rotation speed. Systems having high antenna rotation speeds, like the Mk 92 radar, require a larger sector to achieve an observable mode 4 display.

When a transponder receives mode 4 challenges, the KIT-lA/TSEC computer decodes the encrypted word. If it detects an invalid challenge, it sends a disparity pulse to Receiver-Transmitter RT-859A/APX-72. When the computer makes a valid mode 4 reply decision, it generates the appropriate reply and sends it to the receiver-transmitter unit for transmission. A transmission signal sample is used to light the REPLY lamp on the Transponder Set Control C-6280A/APX, when the AUDIO-OUT-LIGHT switch is in the AUDIO or LIGHT position. A disparity signal from the KIT-lA/TSEC will inhibit the transmission of a reply. If neither a disparity pulse nor a reply transmission follows the reception of a valid mode 4 interrogation, the MODE 4 CAUTION light on the CY-6816/APX-72 will illuminate. If this situation occurs, check the equipment for a malfunction or improper switch settings. When the MODE 4 CAUTION light illuminates constantly, the causes may be an inoperative KIT-lA/TSEC, an improper mode 4 code, or no code at all loaded into the KIT-lA/TSEC. The MODE 4 CAUTION light will not illuminate if the wrong day's code is loaded into the computer or if the mode 4 CODE A/B switch on the C-6280A(P)/APX is in the wrong position.

Control Monitor C-8430/UPX Mode 4 Operation

The control-monitor provides the following controls and alarms for mode 4 operation:

VERIFICATION BITS (1 and 2) (two switches).—Both switches have two positions, marked NORMAL and TEST. They are usually set to the NORMAL position. If you need to differentiate a target previously identified in mode 4 from other mode 4 targets, move the Bit 1 switch to the TEST position and have the target squawk RAD TEST. Verify bit number 2 is not used at this time.

CODE A/B Select.—Each code table loaded into a crypto computer consists of two separate variables: code A is for the current crypto period and code B for the following crypto period. Normally the code select switch is set to A. However, should the ship's operations or a maintenance problem preclude loading the next key extract at the required time, you may place the CODE SELECT switch in the B position. This will allow you to continue operations with crypto-secure identification since the proper day's code will be enabled within the computer.

CAUTION

Operation in code B prior to the designated crypto period is a security violation. If you have to operate in code B, have the operation reported to the CMS officer, who will notify the National Security Agency (NSA).

ZEROIZE Control and Alarm.—The settings of the ZEROIZE/ALARM switch are NORMAL and ZEROIZE, with the usual operating position being NORMAL. When the switch is in the NORMAL position, the ZEROIZE ALARM is deenergized. Moving the switch to the ZEROIZE position will dump (remove) the code from the crypto computer and energize the ZEROIZE ALARM indicator. This switch has a hinged cover to prevent accidental zeroizing.

LOCKOUT OVERRIDE and Alarm.—The settings of the LOCKOUT OVERRIDE switch are NORMAL and LOCKOUT OVERRIDE, with the usual operating position being NORMAL. During a lockout condition, (KIR-lA/TSEC crypto computer malfunctions) the LOCKOUT ALARM indicator light will be energized. If the tactical action officer determines that mode 4 must continue to operate under such circumstances, you may override the KIR-lA/TSEC lockout by placing the switch in the OVERRIDE position. This may or may not restore mode 4 interrogation capability. If you must operate in the OVERRIDE position, have the operation reported to the ship's CMS officer as a potential security violation. The override is also protected with a switch guard to prevent accidental operation.

Control Enclosure CY-816/APX Mode 4 Operation

The CY 6816/ enclosure houses the Transponder Set Control C-6280A(P)/APX-72. The enclosure contains the MODE 4 CAUTION lamp and its test switch, which is marked TEST/NORMAL. The switch is spring-loaded and assumes the NORMAL position by itself. When the switch is held in the TEST position, the lamp socket is energized for testing the light bulb. With the switch in the NORMAL position, illumination of the MODE 4 CAUTION lamp will indicate a failure or improper operation of the transponder set. Although we discussed some of the

causes of a MODE 4 CAUTION indication earlier, we provide a brief summary below.

1. TRANSPONDER SET CONTROL CAUSES OF CAUTION LIGHT ACTIVATION

   a. The MASTER switch is in STBY (standby) when the transponder is receiving valid mode 4 interrogations.

   b. The MODE 4 ON/OUT switch is in the OUT position when the transponder is receiving valid mode 4 interrogations.

   c. The CODE switch is in the ZERO position (this dumps the code from the computer).

2. TRANSPONDER CRYPTO COM PUTER CAUSES OF CAUTION INDICATION

   a. There is no 115V ac power to the computer.

   b. An invalid code has been inserted.

   c. There is no code in the computer or the computer is dismounted.

   d. The computer's automatic self-test function detects a fault.

NOTE

A wrong day's code in the computer will NOT cause the CAUTION lamp to light.

3. RECEIVER-TRANSMITTER CAUSES OF CAUTION LIGHT ILLUMINATION

   a. A receiver-processor is misaligned or a transmitter has failed.

   b. The CAUTION light circuit has failed.

Transponder Set Control C-628OA(P)/APX and C-10533/APX-100 Mode 4 Operation

The transponder control unit provides the following controls and indicators for mode 4 operation:

CODE Switch.—The CODE switch, a four-position switch, is the master control for code selection and retention. This switch allows you to selection codes A or B or the code ZEROIZE function for the KIT-lA/TSEC transponder computer. Normally the CODE switch is operated in the code A position. The ZEROIZE position of the switch causes the computer to dump (remove) its code. The HOLD position is used only in aircraft installations and allows code to be retained when power is removed. The HOLD position is not operative in shipboard installations.

REPLY Indicator.—If the AUDIO/OUT/LIGHT switch is in the AUDIO or LIGHT position, this indicator lights when the receiver-transmitter transmits replies to a valid mode 4 interrogation. It also lights when pressed for the lamp self-test function.

MODE 4 Switch.—In the ON position, the MODE 4 switch enables the KIT-lA/TSEC computer to process and reply to mode 4 interrogations. In the OUT position, it disables computer operation. Additionally, a TEST in the OUT position is found on the C-10533/APX-100, allowing for mode 4 self-test of the transponder set. This mode 4 self-test function works in conjunction with the TEST GO and TEST/MON NO GO indicators. The KIT indicator may also illuminate when mode 4 fails self-testing on the AN/APX-100 transponder set.

AUDIO/OUT/LIGHT Switch.—In the AUDIO position, the switch enables both AUDIO and REPLY light monitoring of mode 4 transponder replies. AUDIO monitoring is seldom used on shipboard installations. In the LIGHT position, the switch enables only the REPLY light to monitor mode 4 replies. This is the recommended switch setting. In the OUT position, the switch disables both AUDIO and REPLY light monitoring of mode 4 transponder replies.

RAD TEST/OUT/MON Switch.—When held in the RAD TEST position (momentary), this switch enables the transponder to reply with a mode 4 form of identification of position (I/P). This works in conjunction with VERIFICATION BIT 1 selection on the Control Monitor C-8430/UPX. Push the switch to this position only on the request, by voice communication, of an interrogating ship or aircraft. Otherwise, RAD TEST will invalidate the code loaded into the KIT-lA/TSEC computer, preventing replies to mode 4 interrogations. With the switch in the MON position (C-6280A(P)/APX only), the monitor circuits of test set TS-1843/APX-72 are enabled (not applicable to mode 4 replies), and the TEST light is energized if reply parameters are normal. In the OUT position, the switch disables the RAD TEST and MON modes of operation.

TEST GO Indicator (C-10533/ APX- 100 only).—A valid reply during mode 4 self-testing will light this indicator. The lamp also has a press-to-test feature.

TEST/MON NO GO Indicator (C-10533/APX-100 only).Failure of the mode 4 self-test to produce a valid reply illuminates this indicator. The lamp also has a press-to-test feature.

STATUS KIT (C-10533/APX-100 only).—This indicator energizes during mode 4 self-test to signal a KIT-lA/TSEC problem.

Crypto Computers KIR-lA/TSEC and KIT-lA/TSEC

The KIR-1A/TSEC interrogator computer provides mode 4 encoding and decoding for the interrogator. It encodes challenges to be transmitted by the interrogator and decodes transponder replies for display on the radar indicator. The operator may select either of two preset codes with the CODE A/B select switch on Control-Monitor C-8430/UPX in CIC. The KIR-1A/ TSEC is loaded through its code changing assembly. The keying variables, codes A and B for two successive crypto periods, are first set manually into the KIK-18/TSEC keyer. The keyer is then inserted into the code changer assembly of the computer. When the keyer is removed and the code changer access door is closed, the code is set.

The mode 4 transponder computer's operation is controlled by Transponder Set Control C-6280A(P)/APX-72, located in CIC. The KIT-lA/TSEC computer is also loaded, in the same manner as the KIR-1A/TSEC computer, through its code changing assembly.

The code is usually set in the KIK-18/TSEC crypto code keyer in the same area where the key lists are secured. The approved method is to have two people load the keyer; one reads the code while the other loads the code into the keyer. After the loading is completed, the code is verified, with the two people reversing positions and reading the code again. With each pin correctly positioned, the two keys, code A and code B, covering two successive crypto periods, are ready for loading into the computers. The operational codes are listed in the current edition of the AKAK 3662 key list. The AKAK 3662 does not have an official title but is referred to simply as the mode 4 "operational code" or "code of the day".

CAUTION

The KIK-18/TSEC keyer is unclassified when zeroized but becomes CONFIDENTIAL with a code loaded into it.

Mode 4 replies are displayed on the display unit as single slashes similar to bracket decoded replies. Long- and medium-range detection systems normally display mode 4 video 1 mile behind radar video. Short-range systems display the mode 4 video 1/2 mile or less behind radar video. See figure 8-25.

IFF OPERATIONS BREVITY CODES

For voice communication with military craft, a set of standard brevity codes has been established by an Allied Communication Publication (ACP 160A). These voice codes enhance IFF operation, permitting the rapid identification of aircraft under control of ships and the communication of IFF equipment operating status. See tables 8-3 and 8-4.

Q5.   How is a Mode 4 challenge initiated?

Table 8-4.—Mode 4 Brevity Codes

CODE	MEANING
SQUAWK FOUR	Turn MODE 4 switch on.
CHECK SQUAWK FOUR	Ensure emitting current crypto period key setting.
STRANGLE FOUR	Turn MODE 4 switch off. Continue squawking other applicable modes.
NEGATIVE SQUAWK FOUR	MODE 4 interrogation/reply not received.
SQUAWK FOUR BENT/SOUR	MODE 4 inoperative/malfunctioning.
IDENTIFY SQUAWK FOUR	Reidentify target/hostile aircraft.

ANSWERS TO CHAPTER QUESTIONS

A1. An interrogator subsystem and a transponder subsystem.

A2. Mode C. Altitudes range from -1,000 feet to + 126,700 feet in 100-foot increments.

A3. Transponder Set Control C-6280A(P)/APX.

A4. Four pulses, approximately 2 miles apart.

A5. By using the mode 4 override function.