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NSRAAM CAPTIVE TEST UNIT DESCRIPTION AND AIRCRAFT/AVIONICS INTE--ETC(U)
JAN 76 R HINKEL, G N JONES, R R LINDEMANN
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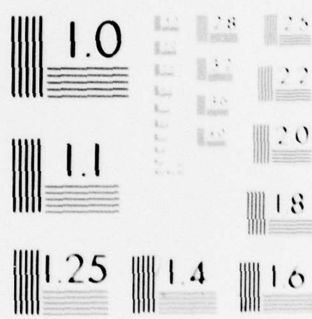

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NWC Technical Memorandum 2656

NSRAAM CAPTIVE TEST UNIT DESCRIPTION AND AIRCRAFT/AVIONICS INTERFACE DEFINITION

FINAL

by

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NWC-TM-2656

JANUARY 1976

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NAVAL WEAPONS CENTER
China Lake, California

1978

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GENERAL DOCUMENT SUMMARY SHEET

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1. ACCESS NUMBER E117-0623	2. COMPONENT/PART NAME PER GIDEP SUBJECT THESAURUS General Technical Data, Design, Construction, and Modification	
3. APPLICATION Missile Air Launch	4. MFR NOTIFICATION ☐ NOTIFIED ☒ NOT APPLICABLE	5. DOCUMENT ISSUE (Month/Year) January 1976
6. ORIGINATOR'S DOCUMENT TITLE NSRAAM Captive Test Unit Description and Aircraft/Avionics Interface Definition		7. DOCUMENT TYPE ☒ GEN RPT ☐ NONSTD PART ☐ SPEC
8. ORIGINATOR'S DOCUMENT NUMBER NWC TM 2656	9. ORIGINATOR'S PART NAME/IDENTIFICATION N/A	
10. DOCUMENT (SUPERSEDES) (SUPPLEMENTS) ACCESS NO. None	11. ENVIRONMENTAL EXPOSURE CODES YUTHAVSNRZW	
12. MANUFACTURER N/A	13. MANUFACTURER PART NUMBER N/A	14. INDUSTRY/GOVERNMENT STANDARD NUMBER N/A

15. OUTLINE, TABLE OF CONTENTS, SUMMARY, OR EQUIVALENT DESCRIPTION

This paper defines the Navy Short Range Air-to-Air Missile (NSRAAM) concept, and presents a detailed description of the functional modes of operation, the Captive Test Unit (CTU), and the interface requirements for the implementation of the Navy SRAAM concept on AIMVAL aircraft.

The Navy SRAAM concepts, Delta and Echo, are based upon heads-up, Off-Boresight Angle (OBA) slaving of missile seekers having increased sensitivity. The present method of achieving heads-up, large off-boresight seeker slaving is the Visual Target Acquisition System (VTAS) which employs a Helmet Mounted Sight (HMS). The surrogate seeker (SS-2) to be used to evaluate the Navy SRAAM concept in AIMVAL employs a three-axis gimbal system and a rotating optical telescope.

Increased seeker sensitivity from present short range air-to-air missiles will provide longer detection ranges against airborne targets especially when viewed from head-on. Large OBA acquisition and launch capability will provide missile launch opportunities not available with present SRAAM missiles. These two features provide an increased opportunity of launch against a projected threat armed with an AIM-9L equivalent in the 1980-1990 time frame.

79 04 25 180

* (OBA); Captive Test Unit (Doc Des--M)

16. KEY WORDS FOR INDEXING

Short Range Air-to-Air Missile (SRAAM); Visual Target Acquisition System (VTAS); Helmet Mounted Sight (HMS); Off-Boresight Angle (Cont. In Box 15*)

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NAVY SRAAM CONCEPT - AIMVAL

INTRODUCTION

This paper defines the Navy SRAAM concept, and presents a detailed description of the functional modes of operation, the Captive Test Unit (CTU), and the interface requirements for the implementation of the Navy SRAAM concept on AIMVAL aircraft.

The Navy SRAAM concepts, Delta and Echo, are based upon heads-up, Off-Boresight Angle (OBA) slaving of missile seekers having increased sensitivity. The present method of achieving heads-up, large off-boresight seeker slaving is the Visual Target Acquisition System (VTAS) which employs a Helmet Mounted Sight (HMS). The surrogate seeker (SS-2) to be used to evaluate the Navy SRAAM concept in AIMVAL employs a three-axis gimbal system and a rotating optical telescope.

Increased seeker sensitivity from present short range air-to-air missiles will provide longer detection ranges against airborne targets especially when viewed from head-on. Large OBA acquisition and launch capability will provide missile launch opportunities not available with present SRAAM missiles. These two features provide an increased opportunity of launch against a projected threat armed with an AIM-9L equivalent in the 1980-1990 time frame.

The objective of AIMVAL is to evaluate the operational utility of seeker sensitivity and off-boresight angle acquisition and launch capability. If this operational usefulness is to be extrapolated into determining future joint SRAAM operational requirements, then the Navy SRAAM concept needs to be evaluated without regard to the eventual missile which would employ this concept. Specific missile design parameters such as cost, size, weight, and control system can, and should, be influenced by the needs of all the users of the missile.

NSRAAM CONCEPT

The Short Range in Short Range Air-to-Air Missile (SRAAM) has been defined as within visual range of the target or, approximately, five miles. The Navy SRAAM concept is to be employed, primarily, in all aspects of visual air-to-air engagements ranging from the pure fighter to fighter air superiority missions to the self defense of heavily laden attack aircraft. It is to be used in conjunction with other aircraft weapons and fire control systems.

All modes of operation of the Navy SRAAM are categorized by the acquisition aide used to slave the Navy surrogate seeker to achieve target lock-on and track. The modes of operation are as follows:

VTAS - provides slaving of the Navy surrogate seeker to the limits of the seeker or to the OBA limits established for specific AIMVAL tests.

Radar - provides slaving of the Navy surrogate seeker to the limits of the specific AIMVAL aircraft radar limits.

Corridor Scan - provides single bar slaving of the Navy surrogate seeker in a vertical plan perpendicular to the aircraft wings.

Boresight - provides slaving of the Navy surrogate seeker to the aircraft boresight.

Implementation of the Navy SRAAM concept into AIMVAL aircraft shall not alter the existing radar, missile, or gun modes in those aircraft. Simulated firing (launch) of a Navy SRAAM will be accomplished by the normal air-to-air missile firing switch in the AIMVAL aircraft.

In any of the four modes of operation the Navy surrogate seeker slaving and target lock-on can be accomplished using one of two methods. Normal slaving and lock-on is accomplished by use of a Target Acquisition Enable (TAE) switch or similar separate IR missile function switch. Activating the TAE switch enables slaving signals to go to the Navy surrogate seeker and commands the seeker to attempt target lock-on. Seeker lock-on is conditioned upon the seeker achieving coincidence with the commanded seeker slaving signals designating the target and sufficient target IR energy received at the seeker. Seeker lock-on indications to the aircrewman are by both visual and audio cues. With seeker lock-on, the aircrewman activates the missile firing switch to simulate missile launch.

The second method of achieving Navy surrogate seeker slaving, track, and simulated launch is termed Quick Fire. The aircrewman activates the missile firing switch only. Seeker slaving signals and a lock-on command signal are delivered to the Navy surrogate seeker as if the TAE switch had been activated as in the normal method. When the surrogate seeker achieves target lock-on, the lock-on signal completes the firing circuit and a simulated missile firing signal is generated. Visual and audio lock-on cues are the same as in the normal method, (but may not all appear distinctly due to the automatic nature of the functions in this method of employment).

FUNCTIONAL MODES OF OPERATION

VTAS - The primary mode of operation of the Navy SRAAM concept is Visual Target Acquisition System (VTAS). VTAS is a system whereby the Navy surrogate seeker is driven to the Line-of-Sight (LOS) generated by an aircrewman using a Helmet Mounted Sight (HMS). The VTAS mode consists of the HMS system, a VTAS computer and the TAE switch.

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The TAE switch serves two functions. The TAE switch enables the seeker to be driven to the VTAS computed LOS, and commands the seeker to go into the track mode.

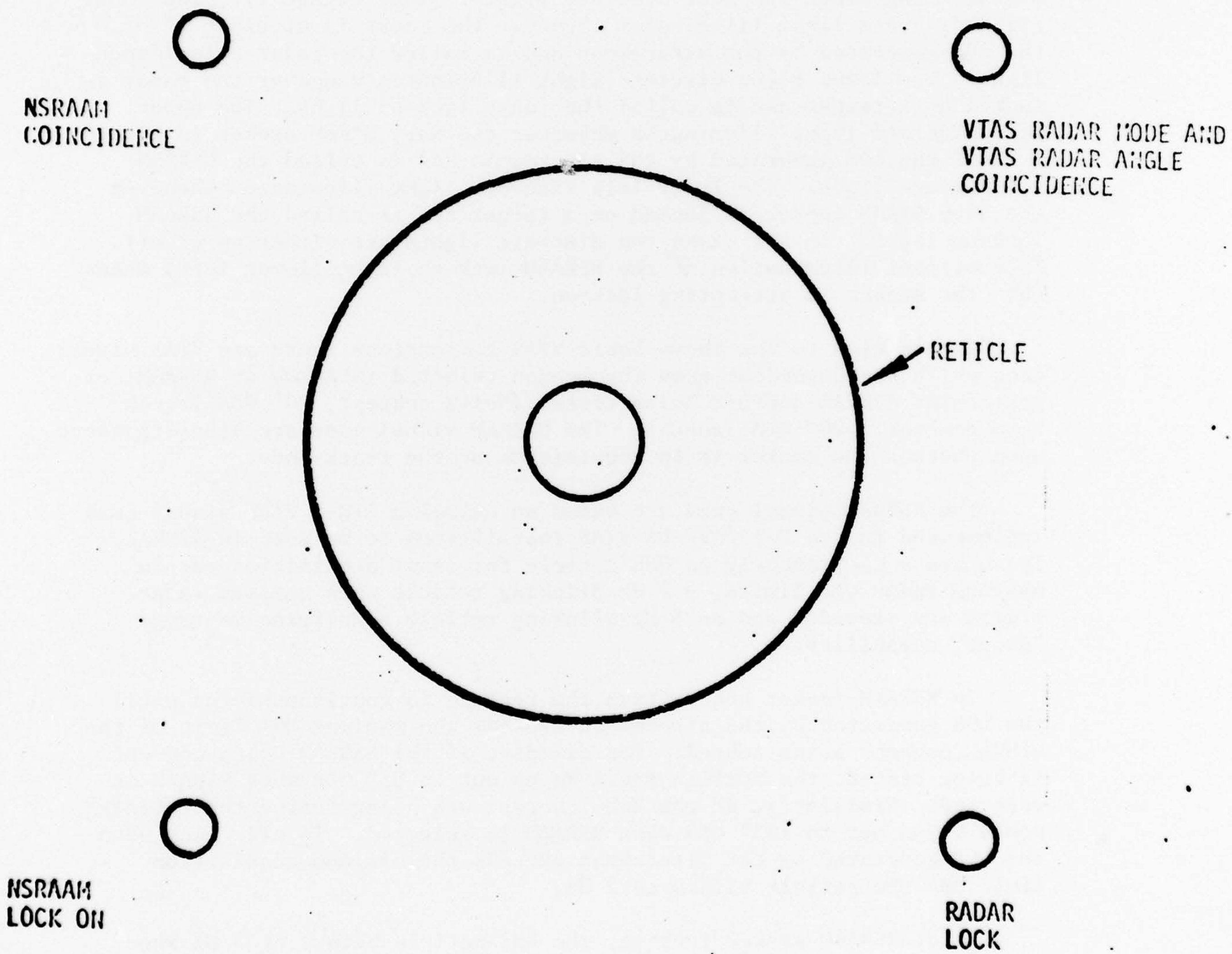
The HMS display for generating the aircrewman's LOS to the target is on the helmet visor. This display consists of concentric 10 and 50 mil sighting rings and four discrete lights. (See Figure 1). The upper right discrete light illuminates whenever the radar is within ± 2° of the LOS generated by the aircrewman and is called the radar coincidence light. The lower right discrete light illuminates whenever the radar is locked on a target and is called the radar lock-on light. The upper left discrete light illuminates whenever the Navy SRAAM seeker is within ± 2° of the LOS generated by the aircrewman and is called the NSRAAM coincidence light. The lower left discrete light illuminates whenever the Navy SRAAM seeker is locked on a target and is called the NSRAAM lock-on light. In all cases the discrete lights are either on or off. Intermittent illumination of the NSRAAM lock-on light (lower left) means that the seeker is attempting lock-on.

In addition to the above basic VTAS indications there are VTAS visual cues which are dependent upon the weapon selected (SPARROW or NSRAAM) or particular AIMVAL concept being tested (Delta concept, 70° OBA launch-Echo concept, 120° OBA launch). The NSRAAM visual cues are also dependent upon whether the seeker is in acquisition or the track mode.

The NSRAAM visual cues are based on existing AIM-7 VTAS visual cues implemented in the F-14/AVG-8A VTAS installation to be used in AIMVAL. These are a continuously on HMS reticle for radar acquisition out to maximum radar OBA limits, a 2 Hz blinking reticle when maximum radar limits are exceeded and an 8 Hz blinking reticle signifying in range "shoot" capability.

In NSRAAM seeker acquisition the reticle is continuously on until the LOS generated by the aircrewman exceeds the maximum OBA limit of the AIMVAL concept being tested. For example, if the NSRAAM Delta concept is being tested, the reticle would be on out to 85° OBA when NSRAAM is selected. Similiarly, if the Echo concept was being tested the reticle would be on out to 135° OBA when NSRAAM is selected. In all cases when the LOS generated by the aircrewman exceeds the maximum acquisition limit OBA the reticle blinks at 2 Hz.

After NSRAAM seeker lock-on, the HMS reticle blinks at 8 Hz when the seeker is within launch OBA limits. That is 70° OBA for the Delta concept or 120° OBA for the Echo concept. This corresponds with a "shoot" indication if present in the AIMVAL aircraft, but does not necessarily imply that a radar lock-on and subsequent aircraft in-range solution has been achieved. If the generated VTAS LOS exceeds launch limits but does not exceed maximum acquisition OBA limits, then the reticle remains steady as in the acquisition case.



VTAS HELMET MOUNTED SIGHT DISPLAY
FIGURE 1

In both the acquisition and lock-on cases an absent reticle is due to one of the following three reasons:

1. The aircrewman has placed his head *outside* the "head box" area or area inside the cockpit in which the HMS system can generate a LOS.

2. There are no more simulated NSRAAMS available on the aircraft.

3. The VTAS is inoperative.

In addition to the above described visual cues there are audio cues which denote seeker target detection and lock-on. In the VTAS mode, as well as all other modes, there will be a 1000 Hz synthetically generated tone heard by the aircrewman whenever sufficient IR energy is received within the seeker Field-of-View (FOV). When the seeker is locked on a target a 5 Hz signal (similar to the AIM-9L "chirp") modulates the 1000 tone. When designating a target using VTAS, the 1000 Hz tone should correspond to the NSRAAM coincidence light being illuminated, and the 5 Hz modulated 1000 Hz tone to the NSRAAM lock-on light being illuminated.

a. Normal Operation - With the VTAS mode selected and NSRAAM selected and the TAE switch not activated, the Navy Captive Test Unit (CTU) remains in the cage position. When the TAE switch is placed in "half action" (half-way depressed) the CTU seeker slaves to the aircrewman's LOS (target). When the seeker LOS is within $\pm$ 2° of the VTAS LOS, the seeker coincidence logic is satisfied and the coincidence discrete light illuminates. The 1000 Hz tone will be heard if the target energy received is sufficient for acquisition. The TAE switch is then placed in "full action" (fully depressed) enabling the CTU to enter the track mode when the following conditions are met: first - track enable, second - LOS coincidence, third - target of sufficient energy detected within the FOV. When the CTU is tracking, the lock-on tone is heard. With the CTU in the track mode, simulated firing can be achieved by depressing the missile fire switch if the OBA is less than launch angle (Delta concept 70°, Echo concept 120°).

b. Quick Fire - With the VTAS mode selected and NSRAAM selected as before and the TAE switch not activated the CTU seeker remains in the cage position. The aircrewman generates a LOS to the target and depresses the missile firing switch. When the missile fire switch is depressed the following sequence of events occurs: the seeker slaves to the VTAS LOS; coincidence is satisfied ($\pm$ 2°); target detected in the FOV; the CTU enters the track mode and is automatically fired. The visual and audio cues and launch constraints apply as in the normal method of operation.

* CORRIDOR SCAN - The Corridor Scan mode is a mode which can be used to achieve CTU off-boresight angle slaving and lock-on when the VTAS system is inoperative. In Corridor Scan the Navy surrogate seeker is driven by the aircraft avionics to scan a fixed vertical pattern. Vertical is perpendicular to a line through the wings of the aircraft and 0° vertical is at the optical boresight position of the aircraft.

*Corridor Scan Mode is not to be implemented for AIMVAL.

The Corridor Scan pattern is a one bar-width scan pattern from + 10° to + 70° at 60° per second sweep rate. When the seeker detects and locks on a target the NSRAAM lock-on discrete light illuminates. All audio cues remain as in the VTAS mode; however, the launch constraint is a fixed 70° OBA.

a. Normal Operation - With Corridor Scan selected and SRAAM selected and the TAE switch not depressed the Navy surrogate seeker remains in the cage position. With the TAE switch in half action the seeker is commanded to slave from + 10° to + 70° at 60° per second sweep rate. Depressing the TAE switch to full action enables the CTU to go into the track mode while continuing the Corridor Scan pattern. The CTU will go into the track mode when the following conditions are met: first - track enable; second - target detected in the field of view. When the CTU is in the track mode it can be fired by depressing the missile fire switch.

b. Quick Fire - With Corridor Scan selected and NSRAAM selected as before and the TAE switch not activated the CTU seeker remains in the cage position. If a target is sighted, the aircrewman depresses the missile firing switch and maneuvers the target into the area of the Corridor Scan pattern. When the missile fire switch is depressed and the target is in the Corridor Scan pattern of the Navy surrogate seeker the following sequence of events occurs: the seeker slaves to the Corridor Scan pattern; target detected in the FOV; the CTU enters the track mode and is fired automatically.

BORESIGHT - The Boresight mode is a mode which is used by an aircrewman to override other functional modes of operation when it becomes advantageous to do so. Therefore, a specifically selectable boresight mode is required to command seeker slaving to the aircraft optical boresight position. When the seeker locks on to a target in the boresight mode the NSRAAM lock-on light will illuminate; audio cues remain the same and the launch constraint is the limit of the NSRAAM concept being tested.

a. Normal Operation - With Boresight selected and NSRAAM selected and the TAE switch not activated the Navy surrogate seeker is commanded to slave to the aircraft optical boresight position. The TAE switch in half action serves no function in this mode. The target is acquired using the gunsight reticle or Heads Up Display (HUD). Depressing the TAE switch to full action enables the seeker to go into the track mode when the following conditions are met: first - track enable; second - target detected in the FOV. With the CTU in the track mode simulated firing can be achieved by depressing the missile firing switch.

b. Quick Fire - With Boresight selected and NSRAAM selected as before and the TAE switch not activated the Navy surrogate seeker is commanded to slave to the aircraft optical boresight position. If a target is sighted the aircrewman depresses the missile firing switch and maneuvers the target to boresight. When the missile fire switch is depressed and the target is in the FOV of the seeker at boresight the following sequence of events occurs: target detected in the FOV; the CTU enters the track mode and is automatically fired.

RADAR - The Radar mode is a method of achieving Navy surrogate seeker slaving and lock-on with the assistance of the aircraft radar. It is not a true functional mode in that it need not be specifically selected and can be used in conjunction with all other modes of operation. The Radar mode can be used anytime that the radar is functional. When the radar locks on to a target and NSRAAM is not selected all that remains is for the aircrewman to select NSRAAM. The Navy surrogate seeker then slaves to the radar LOS and locks on the target. When the seeker locks on to a target in the Radar mode the NSRAAM lock-on light illuminates; audio cues remain the same and the launch constraint is the limits of the NSRAAM concept being tested.

a. Normal Operation (VTAS) - With VTAS mode selected and NSRAAM <u>not</u> selected the VTAS can be used to achieve radar lock-on. The aircrewman generates a LOS to a target and depresses the TAE switch enabling the radar to slave to the VTAS. When the radar LOS is within $\pm$ 2° of the VTAS LOS the radar coincidence light illuminates. With the TAE switch in full action the radar is commanded to lock on to the target and the radar lock-on light illuminates. NSRAAM is then selected enabling the CTU to enter the track mode when the following conditions are met: first - track enable; second - LOS coincidence; third - target detected within the FOV. When the CTU seeker is tracking a target the NSRAAM lock-on light illuminates and the lock-on tone is heard by the aircrewman. With the CTU in the track mode simulated firing can be achieved by depressing the missile fire switch. The launch constraint is the limit of the NSRAAM concept being tested.

b. Normal Operation (without VTAS) - When VTAS is not used to assist radar lock-on the sequence of events after radar lock-on is exactly the same as in the normal operation using VTAS. In this method of operation the aircrewman acquires and locks on a target with the radar and simply switches to NSRAAM enabling the CTU to enter the track mode as described above in 'a'.

c. Quick Fire - This method is not applicable in the Radar mode since the NSRAAM seekers are already locked on before the missile fire switch is activated.

NSRAAM CAPTIVE TEST UNIT

The Navy CTU consists of a medium wavelength infrared missile guidance unit, electrical conversion electronics (power supply) and guidance unit to aircraft avionics interface electronics packaged within a 6.5 inch diameter airframe. The CTU is designed for the captive flight environment of the Joint Service AIMVAL Test when carried on existing SIDEWINDER stations of the AIMVAL aircraft.

The design of the guidance unit for the Navy CTU is based upon the ASP-3/3A seekers developed under the AGILE program. Design changes from the existing ASP-3/3A design are associated with adapting the seeker unit electronics to a 6.5 inch diameter airframe and improving reliability. The IR dome, optics (including corrector optics), detector and cryostat, inner and middle gimbal castings for the CTU are one-to-one replacements from the ASP-3/3A design. The hybrid microelectronics modules developed for the ASP-3A are used in the CTU for both reliability and scheduling reasons.

The interface between the CTU and aircraft avionics is both analog and digital to accommodate all the information required to be sent across the interface. Analog interface signals are aircraft 3Ø, 400 Hz, Y-connected power (115 volts line to neutral at 3 amps per phase), CTU audio tone, and CTU aboard the station. The interface electronics in the CTU are designed to provide a serial digital interface between the CTU and aircraft avionics for input and output signals. Digital input signals to the CTU include slaving signals (direction cosines) and CTU mode logic. Digital output signals from the CTU includes seeker head position (direction cosines) and CTU status logic.

The body coordinate system for the CTU is a right-hand direction set with positive X forward, positive Y to the right, and positive Z downward when viewed from the rear of the CTU with the hanger hooks up.

PHYSICAL DESCRIPTION - The airframe structure of the Navy CTU is constructed of thick wall aluminum. AIM-9L hooks are used to interface the structure with the LAU-7/A launcher. The airframe is a closed structure and employs a dessicant breather to prevent moisture build up within the structure during altitude cycling. A preliminary drawing for the CTU is shown in Figure 1. Physical design specifications are listed below:

PARAMETER	VALUE
General Shape	
Diameter, inch	6.5
Length, inch	101.5
Weight, pounds	$\leq$ 160
c.g.	13.5 inches aft of forward launcher attach bolt.

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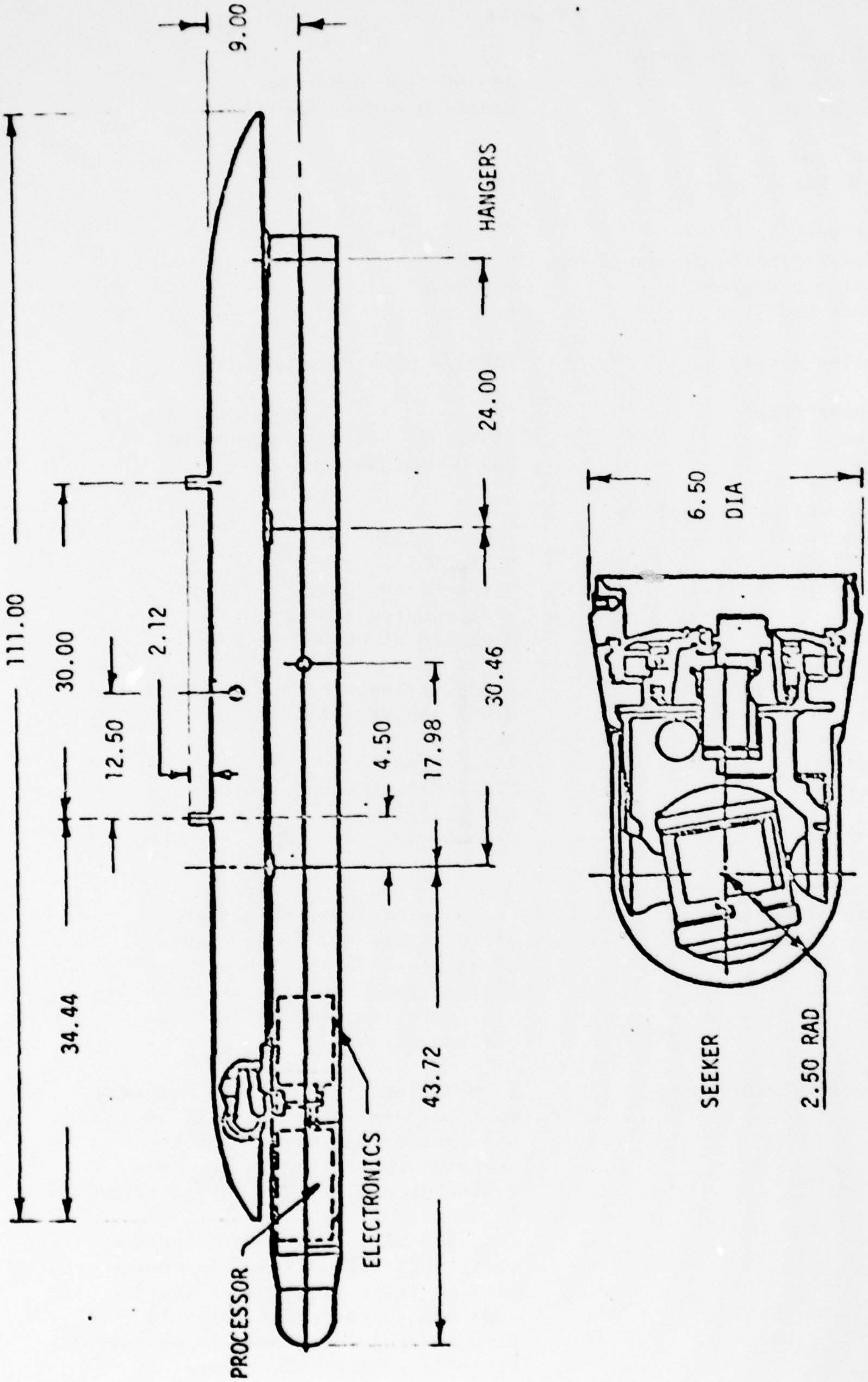

NSRAAM CTU ON LAU-7/A LAUNCHER

FIGURE 1

CTU to launcher attachment	
Mechanical	AIM-9L type hangers.
Electrical	Modified AIM-9L Umbilical
Corridor Scan	
Scan Rate, °/sec	60
Field of View	
Acquisition Equivalent, deg.	3.2 dia
Maximum, degree	3.7 wide
Track Mode, mr	6x8
CTU cooling supply	LAU-7/A bottle (argon gas)
Prime Power Input	
Type	115V, 3Ø, 400 Hz, Y-Connected
Load	Max 3 amp/phase
Environmental Specifications	
Temperature, amb °F	-50 to +155
Altitude, ft	SL to 50K
Acceleration and g loads	MIL-A-8591D (captive flight-wing mounted stores)
Airspeed	Mach 1.6 at 40,000 ft MSL
Minimum Random Vibration	
Level, g^2/Hz	0.027, transverse and vertical
Performance	0.007 longitudinal
rms, g	6.0
Shock	15g, 11 ms
Acoustic	MILSTD810C, Method 515.2 Acoustical Noise, Table 515.2I Category C
EMI Requirements	
General Environment	The Navy CTU must be compatible with the EMI environments of all the AIMVAL aircraft and must perform satisfactorily in all operational modes in these environments.
Special Environment	In addition, the Navy CTU seeker must perform satisfactorily in all operational modes when the seeker is operating in the following special AIMVAL environments. (1) A-7, F-14, F-15 captive carry while the AIS pod is operating at its maximum power level and when the aircraft communication and radar systems are operating at their maximum power levels.

	(2) A-7, F-14, F-15 captive carry while the aircraft radar is operating at its maximum power level and while being radiated by the wingman's fire control radar when it is operating at its maximum power level at the minimum operational separation distance between the two aircraft.
Maintainability	Replacement of seeker head and electronic cards.
Reliability goal	200 mean flight hours between failure.

FUNCTION DESCRIPTION

a. OUTPUT DATA* - The output serial digital word format is shown in Figure 2. The output data enters the CTU via the umbilical cable on pins 8 and 16. Two 31 bit words are sent to the CTU from the aircraft avionics which contain the direction cosines and seeker mode controls. The slaving direction cosines describe a LOS in space referenced to CTU body coordinates. The weighting and scaling of these digital words are defined in the CTU Avionics Interface Description section of this paper. In the slave mode, the CTU converts the direction cosines into the appropriate drive signals to slave the seeker gimbals to the commanded LOS.

The internal mode control for the CTU seeker is derived by the state of M1 and M2 (bit 17 and 16 of word one). The logic table for the status of these bits is shown in Table 1. The logic states described in Table 1 are applicable to all the seeker modes described in the Functional Modes of Operation section of this paper.

TABLE 1

M1	M2	CTU Seeker Mode
1	X	Seeker caged to CTU airframe boresight
0	1	Seeker Slave
0	0	Seeker track enabled

X - indicates a don't care state.

*Input and Output Data referenced to avionics, i.e.,

OUTPUT DATA - AIRCRAFT TO CTU
INPUT DATA - CTU TO AIRCRAFT

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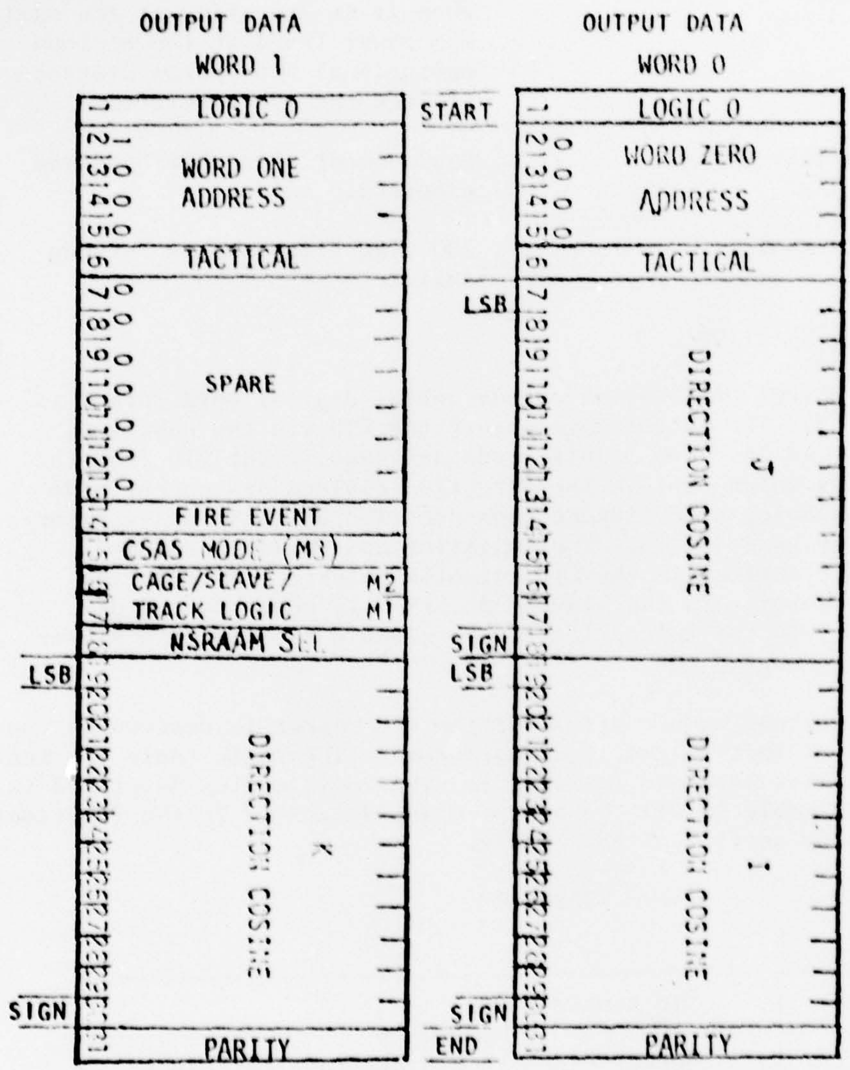


FIGURE 2. OUTPUT DATA WORDS
(AIRCRAFT TO CTU)

Whenever M1 is high (one in Table 1), the seeker is held in the cage position (CTU airframe boresight) independent of the state of M2 or any other input into the CTU. Whenever M1 is low (zero in Table 1) and M2 is high, the CTU seeker is commanded to slave its LOS to the input direction cosines being sent to it by the aircraft avionics. The aircraft avionics provide the proper LOS command signals to the CTU dependent upon the Functional Mode of Operation selected. When M1 and M2 are both low (zero), the CTU is enabled to go into the target tracking condition. The internal CTU logic, however, holds the seeker in the slave mode until two conditions are met; they are angle of coincidence and target detect. When both these conditions are met, the CTU internal logic will switch the seeker mode control from slaving to the external LOS (direction cosines), to the internal target tracking loop. The CTU will remain in target tracking as long as M1 and M2 remain low. The latching of these two bits is accomplished in the aircraft avionics.

*M3 (bit 15 of word one) is sent to the CTU as an indication that the Corridor Scan Functional Mode of Operation is selected. M3 implies that the necessary changes to the CTU processing logic are performed allowing the seeker to acquire a target while being scanned at a high rate.

The Fire Event signal (bit 14 of word one) is sent to the CTU to indicate a missile launch has been initiated. This signal is presently not being used within the CTU.

NSRAAM SELECT (bit 18 of word one) is presently not being utilized within the CTU.

Input power to the CTU is supplied through the CTU umbilical on pins 1, 5, 23, and 9 as shown in Figure 8. The format for the digital clock and the sync line are described in the Aircraft Avionics Requirements section of this paper.

b. INPUT DATA - The input data to the AIU from the CTU consists of analog audio tone and CTU onboard indication signals and an output serial digital word shown in Figure 3. The input serial digital word consists of two 31 bit words which are sent to the aircraft avionics by the CTU via pins 7 and 24 of the CTU umbilical cable shown in Figure 8. The weighting and scaling of these output digital words are described in the CTU Avionics Interface Description section of this paper.

The CTU will provide a steady 1,000 Hz tone of a constant 8.5 vrms whenever a target is within the field of view which satisfies the acquisition requirements and when angle coincidence is satisfied. This tone is designated Target Detect and may be present in the cage, slave, and track enable modes. When the CTU is self tracking a target, the 1,000 Hz tone will be modulated at 5 Hz. This analog tone signal is used as an audio cue through existing SIDEWINDER audio wiring to the aircrewman's headset. The analog CTU onboard indication is achieved by grounding pin 17 of the CTU umbilical as shown in Figure 8. This analog signal must be present in order to allow the analog power input signals into

*Corridor Scan Mode is not to be implemented for AIMVAL.

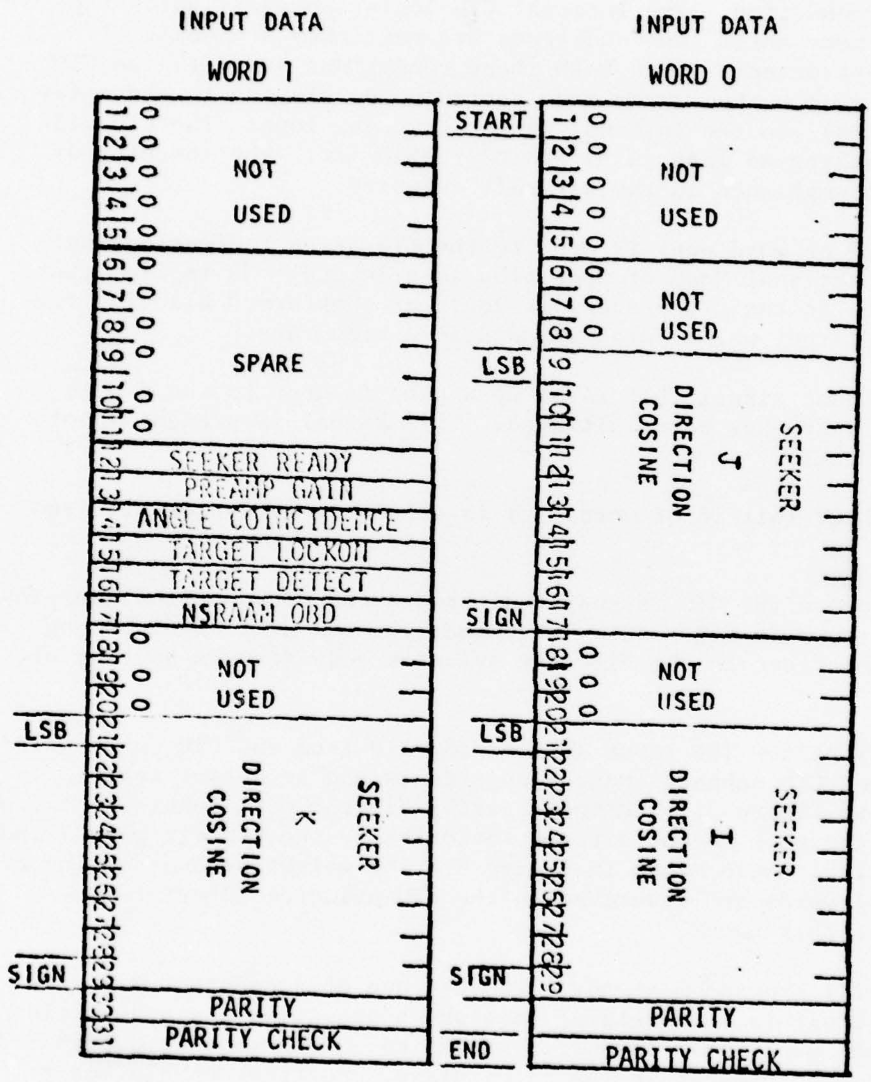


FIGURE 3. INPUT DATA WORDS
(CTU TO AIRCRAFT)

the CTU. The analog tone signal occurs simultaneously with serial digit input word bit TARGET DETECT.

The CTU direction cosines are an indication of the seeker LOS in missile body coordinates and are valid only when the seeker is tracking and TARGET LOCK-ON (bit 15 word one) is present. ANGLE COINCIDENCE (bit 14 word one) is generated in the CTU by comparing the error commands to the gimbal drives with a $\pm 2°$ error voltage level. When the CTU gimbals are within $\pm 2°$ of the commanded LOS, the seeker puts out a one on bit 14 of word one. While slaving, coincidence is determined with respect to the input direction cosines LOS. When CTU is in track, coincidence is determined by the aircraft avionics.

TARGET DETECT (bit 16 word one) is an indication that an IR target with an intensity greater than five times system noise is within the seeker FOV.

TARGET LOCK-ON (bit 15 word one) is a feedback indication to the aircraft from the CTU that is generated by combining the track enable mode with angle of coincidence and then with target detect. TARGET LOCK-ON also indicates that the CTU is self tracking the target.

PREAMP GAIN (bit 13 of word one) is high (on) when the target intensity has exceeded some value and the gain of the preamps has been reduced.

SEEKER READY (bit 12 of word one) indicates that the power supplies are functioning properly and that the seeker detector is cooled.

NSRAAM ONBOARD (bit 17 of word one) is high to signal to the aircraft that the CTU is present.

NSRAAM AIRCRAFT AVIONICS REQUIREMENTS

GENERAL

The Navy SRAAM Aircraft Avionics Requirements outlined in this section are general aircraft requirements which apply to all AIMVAL aircraft. The requirements have been determined in every instance with regard to each aircraft type capabilities. Further, these requirements have been determined with minimum impact upon aircraft and launcher modifications in mind.

It is not implied here that all Functional Modes of Operation expressed in this paper must be implemented on all AIMVAL aircraft if it is not feasible to do so. Neither is it implied that these requirements are a dictation to the specific implementation of the Navy Concept on AIMVAL aircraft except where that implementation effects the Navy CTU.

The NSRAAM CTU avionics are comprised of a Avionics Interface Unit (AIU), a Visual Target Acquisition System (VTAS), an Airborne Instrumentation Subsystem (AIS), and a CTU Digital Interface Unit (DIU). See

Figure 4. The AIU is the central control point for processing of the avionics and CTU information. The AIU computes (digital computer) the LOS coordinate rotation for each CTU aircraft station, controls mode logic and cockpit displays, and processes input commands from the aircrew. The AIU also contains the digital data multiplexer for the CTU and the AIS data formatter. The digital data multiplexer encodes the data for the AIU computer and decodes the multiplexed data from the DIU in the CTU.

The controls and displays for the NSRAAM CTU shall utilize the basic AIM-9 weapon installation functions as much as possible. A basic operating difference between the AIM-9 and NSRAAM CTU is the simultaneous selection of all CTU seekers by the aircrewmen. The NSRAAM CTU avionics are designed to be compatible with existing aircraft avionics weapon systems such as Forward Looking Radar (FLR), AIM-9, AIM-7 and guns. When the NSRAAM CTU is used on the AIMVAL aircraft, it should not alter existing cockpit switchology, displays or usage of these weapon systems.

The VTAS helmet mounted sight system provides LOS data in aircraft coordinates to the AIU. The helmet contains a heads-up display for off-boresight target acquisition. The display is comprised of a reticle and 4 discrete lights. By controlling the reticle state (ON/OFF/BLINK) acquisition and launch limits are indicated to the operator. One (upper left) discrete light is used to indicate angle coincidence between the VTAS and CTU and one (lower left) discrete light is used to indicate CTU target lock-on. After CTU lock-on, the angle coincidence computation is performed in the avionics by comparing the CTU LOS to the VTAS LOS. The AIU computer uses the VTAS LOS data and the seeker LOS data to determine the helmet reticle state. The CTU acquisition and launch limits are also controlled by computation in the AIU.

The basic aircraft configurations for the NSRAAM CTU and AIS pod on the F-14, F-15, and A-7 aircraft are shown in Figures 5, 6, and 7, respectively. All aircraft installations for the CTU utilize a standard LAU-7/A launcher. The pylon and launcher adapters are standard for each individual aircraft. The aircraft modification requires a new electrical adapter harness to be installed in the pylon to supply the necessary CTU power and signal requirements.

AVIONICS INTERFACES

a. CTU Avionics Interface Description - The NSRAAM CTU interface utilizes a new CTU launcher umbilical, Figure 8, that is functionally compatible with the existing LAU-7/A launcher. The CTU electrical signal interface is comprised of: (a) digital serial data transmission lines, (b) prime CTU power, (c) CTU store status, and (d) target tone. In addition, a gas line is contained within the umbilical to provide the seeker detector with argon coolant gas.

The aircraft avionics interface unit (AIU) controls the transmission of the digital serial data to the NSRAAM CTU by providing: (1) a clock signal, (2) a data sync signal, and (3) an output data signal,

AVIONICS FUNCTIONAL BLOCK DIAGRAM

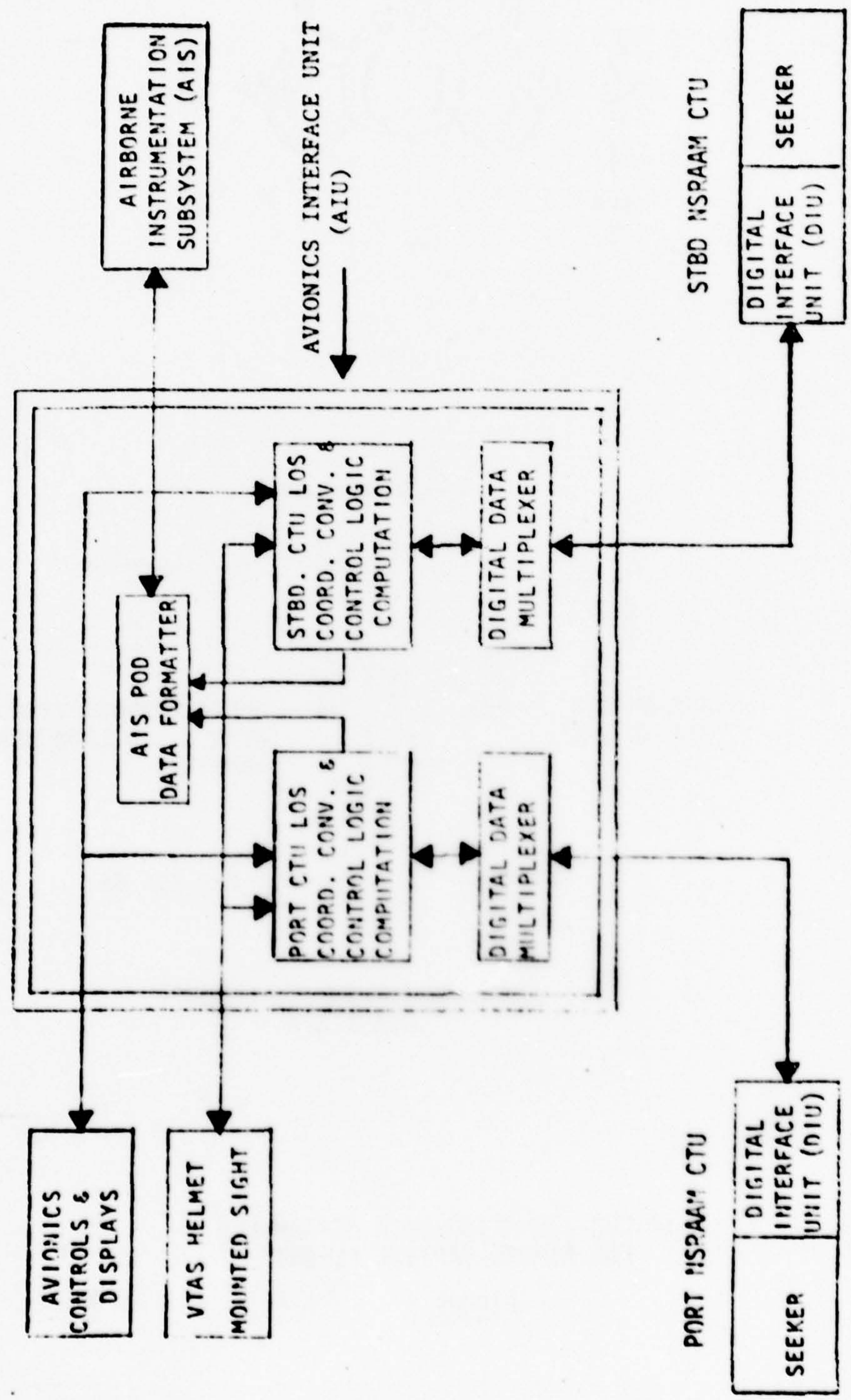
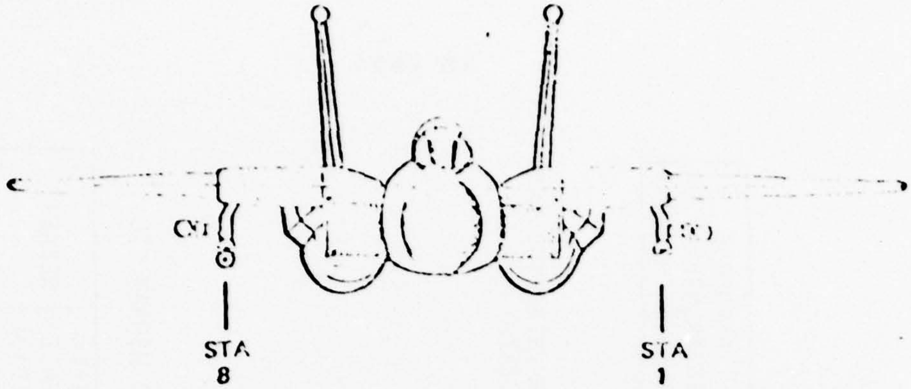
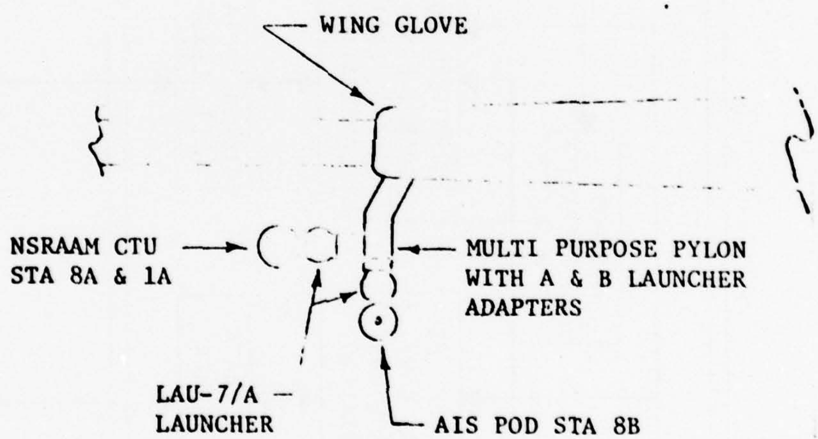


FIGURE 4

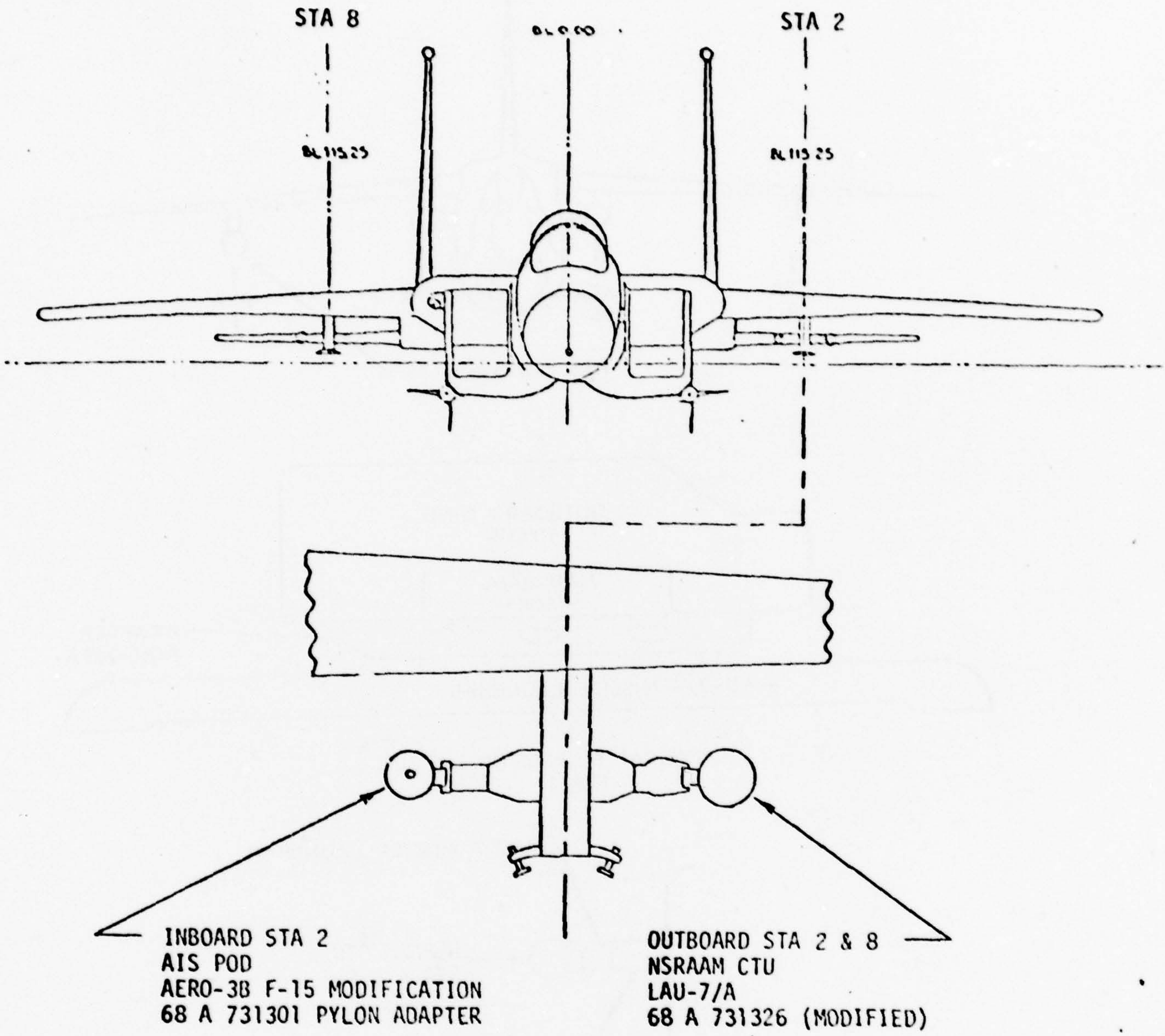




TYPICAL SUSPENSION LAYOUT
STA 1 & 8

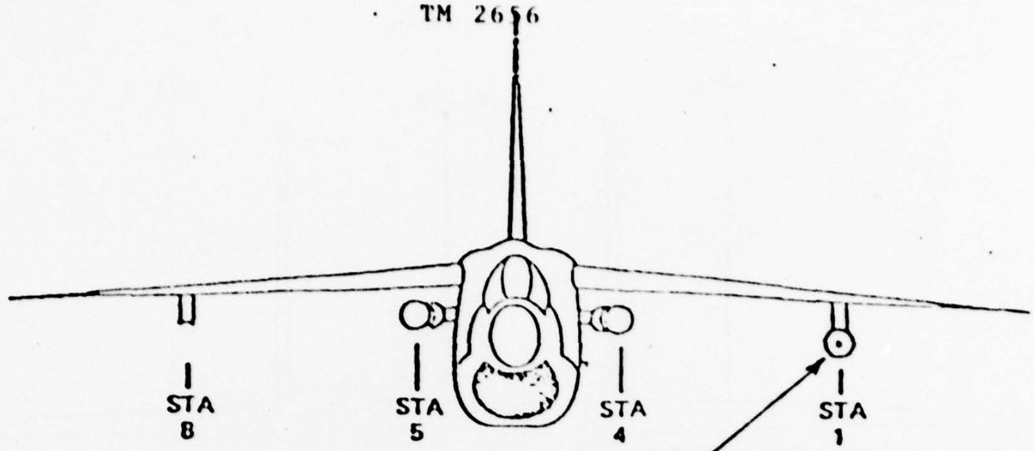
F-14 CONFIGURATION WITH NSRAAM CTU
FOR AIMVAL CAPTIVE FLIGHT

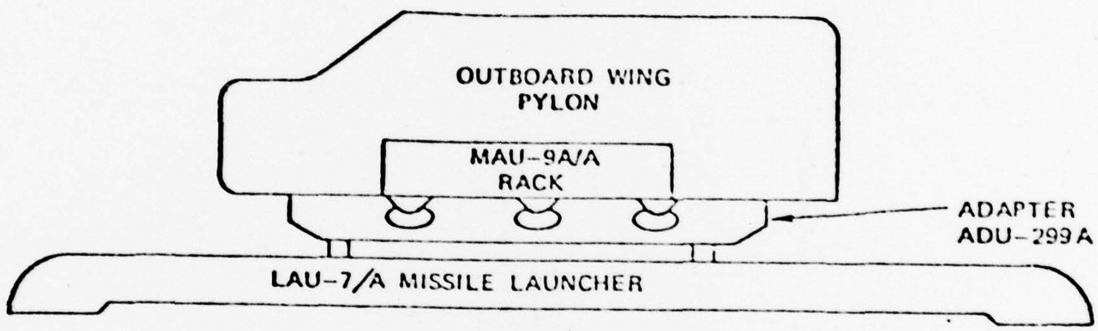
FIGURE 5



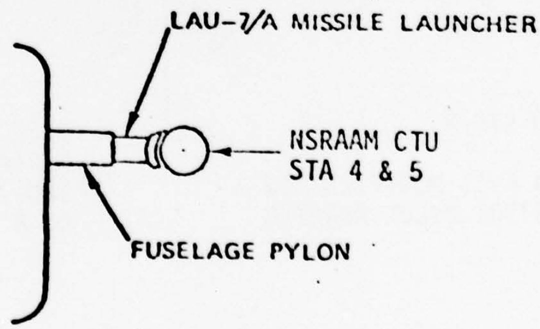
F-15 CONFIGURATION WITH NSRAAM CTU FOR AIMVAL CAPTIVE FLIGHT

FIGURE 6





TYPICAL SUSPENSION LAYOUT
STA 1



TYPICAL SUSPENSION LAYOUT (STA 4 & 5) A-7 AIRCRAFT

A-7 CONFIGURATION WITH NSRAAM CTU FOR AIMVAL CAPTIVE FLIGHT

FIGURE 7

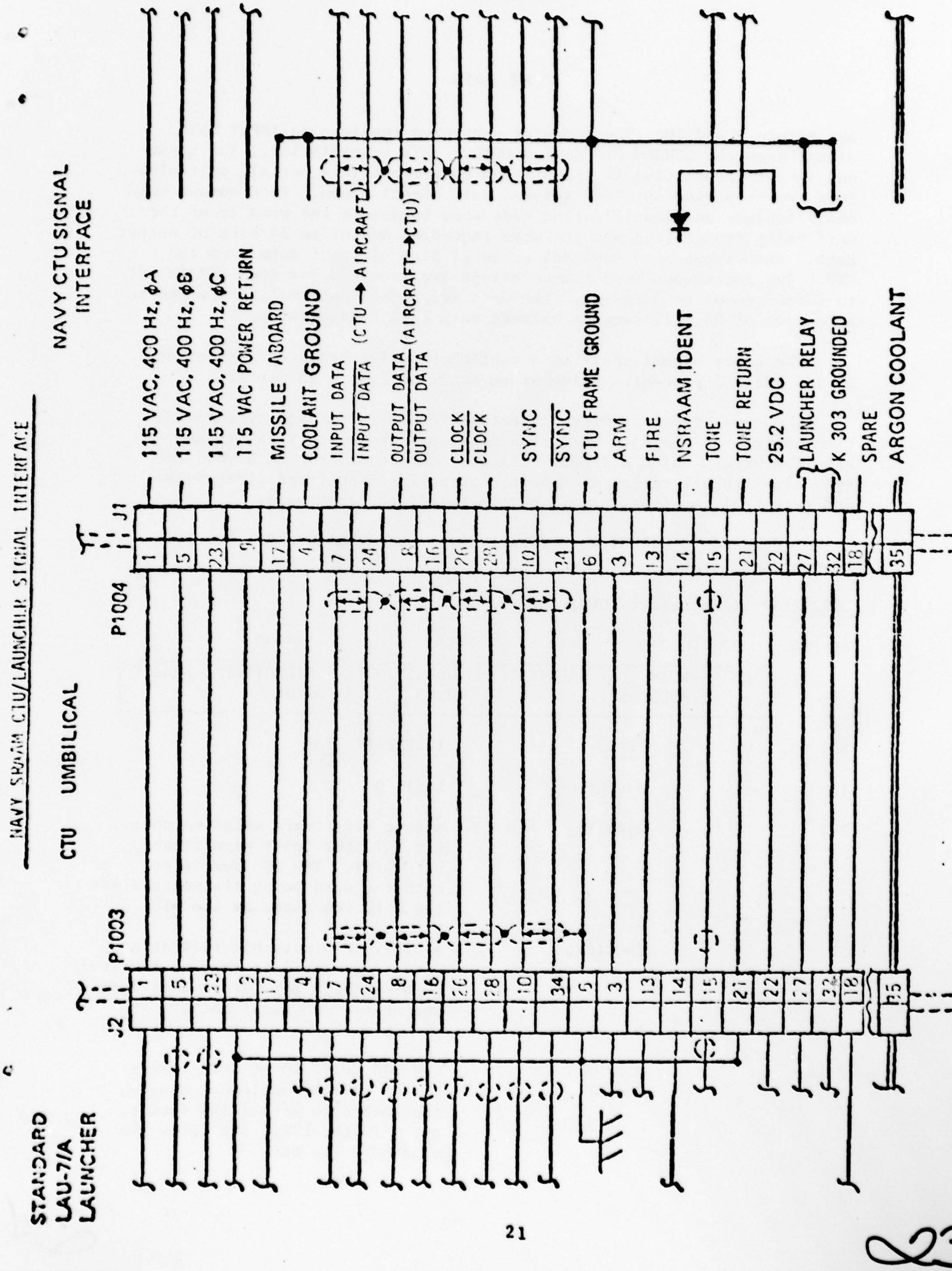

NAVY SRAAM CTU/LAUNCHER SIGNAL INTERFACE
STANDARD LAU-7/A LAUNCHER
CTU UMBILICAL
NAVY CTU SIGNAL INTERFACE
J2
P1003
P1004
J1
115 VAC, 400 Hz, φA
115 VAC, 400 Hz, φB
115 VAC, 400 Hz, φC
115 VAC POWER RETURN
MISSILE ABOARD
COOLANT GROUND
INPUT DATA (CTU→AIRCRAFT)
INPUT DATA
OUTPUT DATA (AIRCRAFT→CTU)
OUTPUT DATA
CLOCK
CLOCK
SYNC
SYNC
CTU FRAME GROUND
ARM
FIRE
NSRAAM IDENT
TONE
TONE RETURN
25.2 VDC
LAUNCHER RELAY
K 303 GROUNDED
SPARE
ARGON COOLANT
1
5
23
9
17
4
7
24
8
16
26
28
10
34
6
3
13
14
15
21
22
27
32
18
35

FIGURE 3

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see Figure 9 and 10. The computer subsystem receives an INPUT DATA signal from the NSRAAM CTU during OUTPUT DATA transmission. The input and output information is transmitted concurrently in serial, multiplexed form over separate shielded twisted pair signal lines. Each output word shall include an identification code used to denote the word ID of the word being transmitted and the word requested and up to 24 bits of output data. Each input word includes up to 24 bits of input data from the CTU. Two contiguous word transmissions are required for each NSRAAM CTU to form a complete data set. The data set update interval is limited to a maximum of 64 milliseconds between each data transmission.

The clock signal shall be a continuous pulse train at a frequency of 125 kHz ± 1 percent. Pulse width shall be 1 μs ± 25 percent.

The sync signal provides interface interrogation and synchronization control of the data word transmission. The sync signal is an envelope within which all data bits are contained. For each word the sync signal shall turnon 4 μs before turnoff of the first clock pulse and turnoff 1 μs after turnoff of the thirtieth clock pulse.

The standard OUTPUT word format is as shown below. Bit No. 1 is transmitted first.

<u>WORD ZERO</u> (Aircraft to CTU)

Bit No.	1	2-5	6	7-18	19-30	31
	NU	WORD ADDRESS	TACTICAL	J DIRECTION COSINE	I DIRECTION COSINE	PARITY

BIT NO.	TYPE	INTERPRETATION
1	Not used	Logic 0
2-5	WORD ID	A four bit binary weighted code. Bit 2 is the least significant bit (LSB). The ID identifies both the word being transmitted are the word requested by the AIU.
6	TACTICAL	A discrete binary bit indicating data transmitted is test or tactical information. Zero state test data. One state - tactical data.
7-18	J DIRECTION COSINE	CTU LOS drive input data transmitted in 2's complement binary, non-return to zero (NRZ) format. Bit 7 is the LSB. Bit 18 is the sign polarity bit.

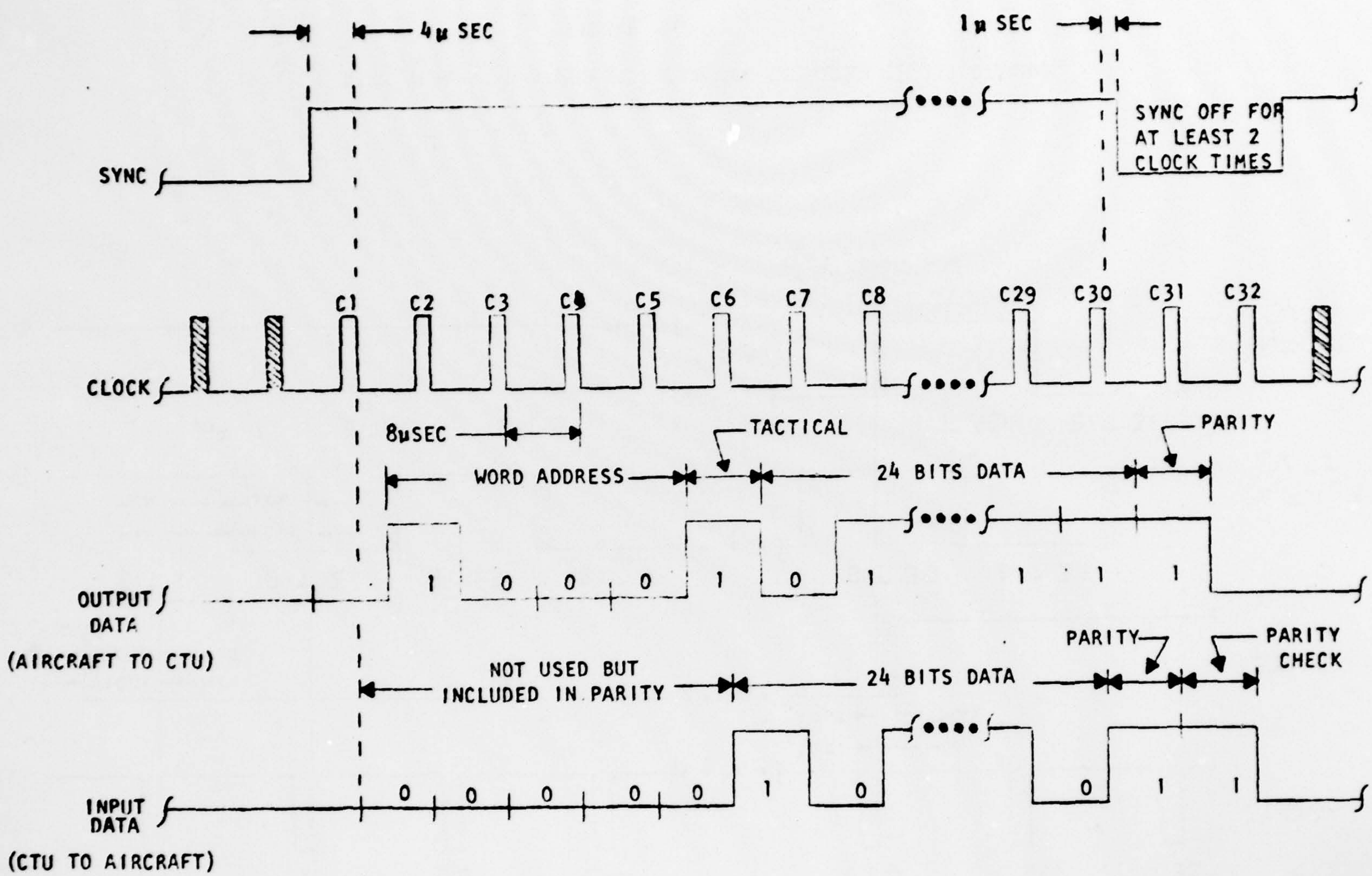
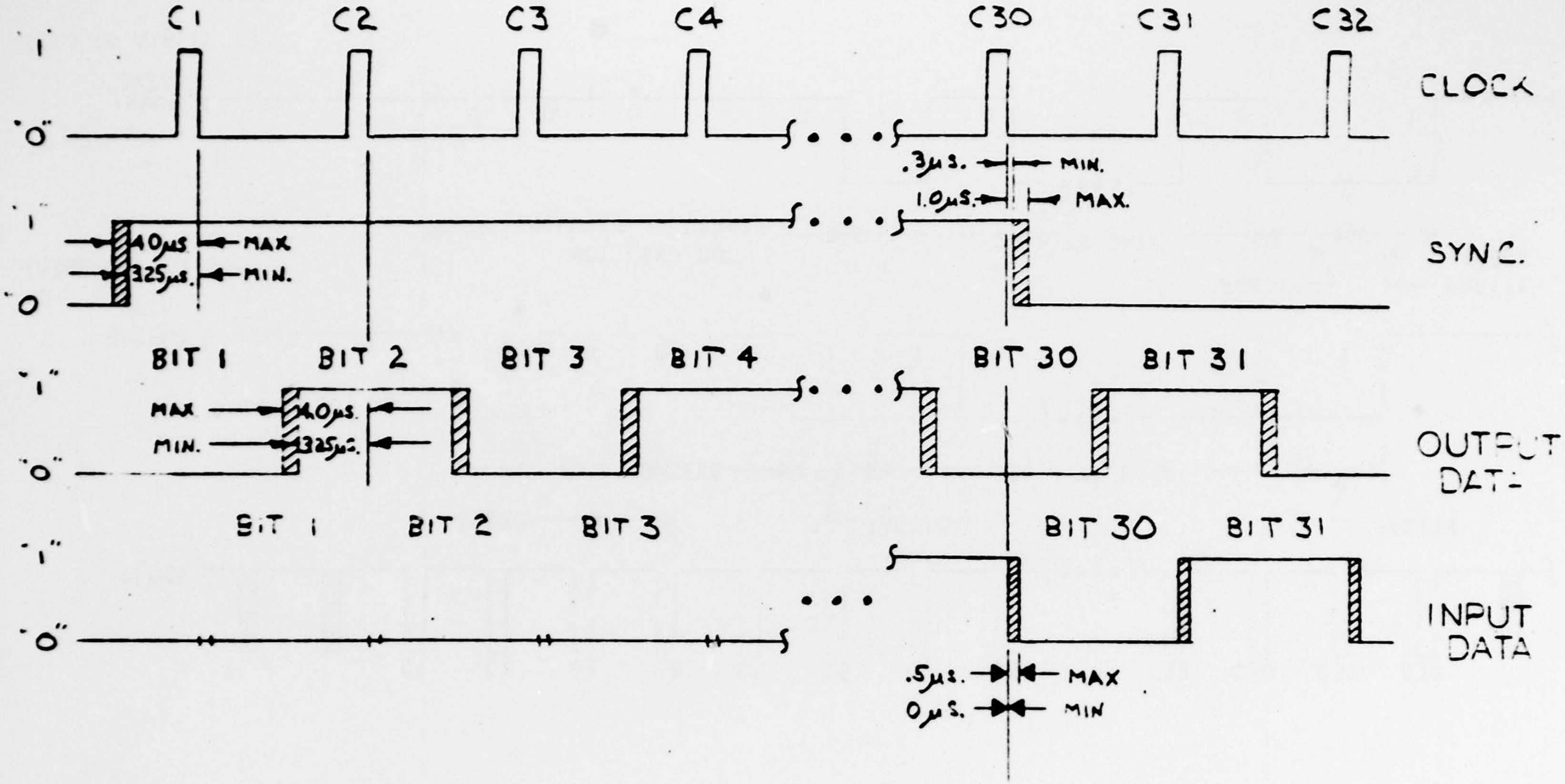


FIGURE 9. NAVY SRAAM CTU/AIRCRAFT DIGITAL SERIAL INTERFACE DATA FORMAT



NAVY GRAAY CTV/AIRCRAFT INTERFACE DETAILED TIMING DIAGRAM

FIGURE 10

BIT NO.	TYPE	INTERPRETATION
19-30	I DIRECTION COSINE	CTU LOS drive input data transmitted in 2's complement binary, NRZ format. Bit 19 is the LSB. Bit 30 is sign polarity bit.
31	PARITY	A discrete binary bit that is assigned a value (0 or 1) such that the total number of ones transmitted is odd. Incorrect parity indication will inhibit the use of output data.

WORD ONE (Aircraft to CTU)

Bit No.

1	2-5	6	7-13	14	15	16-17	18	19-30	31
NU	WORD ADDRESS	TACTICAL	SPARE	FIRE	CSAS	C/S/T	SEL	K DIRECTION COSINE	PARITY

BIT NO.	TYPE	INTERPRETATION
1	Not used	Logic 0
2-5	WORD ID	A four bit binary weighted code. Bit 2 is the LSB. The ID identifies both the word being transmitted and the word requested by the AIU.
6	TACTICAL	A discrete binary bit indicating data transmitted is test or tactical information. Zero state - test data. One state - tactical data.
7-13	SPARES	Logic 0
14	FIRE EVENT	A discrete binary bit indicating the CTU has been fired.
15	*CSAS MODE	A discrete binary bit indicating the CTU is being used in the corridor scan mode.
16-17	CAGE/SLAVE/TRACK MODE	A two bit binary weighted code indicating the CTU seeker command mode logic. Bit 17 is M1. Bit 16 is M2.
18	NSRAAM SELECT	A discrete binary bit indicating the CTU has been selected.

*Corridor Scan Mode is not to be implemented for AIMVAL.

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BIT NO.	TYPE	INTERPRETATION
19-30	K DIRECTION COSINE	CTU LOS drive input data transmitter in 2's complement binary, NRZ format. Bit 19 is the LSB. Bit 30 is sign polarity bit.
31	PARITY	A discrete binary bit that is assigned a value (0 or 1) such that the total number of ones transmitted is odd. Incorrect parity indication will inhibit the use of output data.

The CTU digital interface unit shall be capable of determining which data word is being transmitted according to the preassigned word address code (bits 2-5). The CTU digital interface shall determine the data type (test or tactical) transmitted by examining bit 6 of the Output Data word. When bit 6 is logic one (1) the data transmitted shall be used to control the CTU seeker operation. When bit 6 is logic zero (0) the CTU interface shall: (a) inhibit normal use of the data, and (b) return this data to the aircraft AIU during the next sync transmission received provided bit 6 of the Output Data word remained logic zero.

The standard INPUT word format is shown below. Bit No. 1 is transmitted first.

WORD ZERO (CTU to Aircraft)

Bit No.	1-8	9-17	18-20	21-29	30	31
	NU	SEEKER J DIRECTION COSINE	NU	SEEKER I DIRECTION COSINE	PARITY	PARITY CHECK

BIT NO.	TYPE	INTERPRETATION
1-8	Not used	Logic 0
9-17	SEEKER J DIRECTION COSINE	CTU seeker LOS output data transmitted in 2's complement binary, NRZ format. Bit 9 is the LSB. BIT 17 is sign polarity bit. Valid after lock-on.
18-20	Not used	Logic 0
21-29	SEEKER I DIRECTION COSINE	CTU seeker LOS output data transmitted in 2's complement binary, NRZ format. Bit 21 is the LSB. Bit 29 is sign polarity bit. Valid after lock-on.

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BIT NO.	TYPE	INTERPRETATION
30	PARITY	A discrete binary bit that is assigned a value (0 or 1) such that the total number of ones transmitted (data bits 1 - 30) is odd.
31	PARITY CHECK	A discrete binary bit in dictating the results of the parity check. Zero state - incorrect parity. One state - correct parity.

WORD ONE (CTU to Aircraft)

Bit No.

1-5	6-11	12	13	14	15	16	17	18-20	21-29	30	31
NU	SPARE	RDY	PAGS	COIN	L/O	T/D	ONBD	NU	SEEKER K DIRECTION COSINE	PARITY	PARITY CHECK

BIT NO.	TYPE	INTERPRETATION
1-5	Not used	Logic 0
6-11	SPARES	Logic 0
12	SEEKER READY	A discrete binary bit indicating the detector is cooled, and voltage forms are up.
13	PREAMP GAIN	A discrete binary bit indicating the seeker has switched from low level target to high level target.
14	ANGLE COINCIDENCE	A discrete binary bit indicating the seeker has angle coincidence with the input LOS slave commands. This bit is only valid prior to seeker lock-on.
15	TARGET LOCKON	A discrete binary bit indicating the seeker is tracking a target.
16	TARGET DETECT	A discrete binary bit indicating the seeker has detected a target in the FOV.
17	NSRAAM ONBOARD	A discrete binary bit indicating a NSRAAM CTU is aboard the aircraft store station.
18-20	Not used	Logic 0

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BIT NO.	TYPE	INTERPRETATION
21-29	SEEKER K DIRECTION COSINE	CTU seeker LOS output data transmitted in 2's complement binary, NRZ format. Bit 18 is the LSB. Bit 29 is sign polarity bit. Valid after lock-on.
30	PARITY	A discrete binary bit that is assigned a value (0 or 1) such that the total number of ones transmitted (data bits 1-30) is odd.
31	PARITY CHECK	A discrete binary bit indicating the results of the parity check. Zero state - incorrect parity. One state - correct parity.

The scaling for the serial output data originating from the aircraft AIU is shown in Figure 11. The scaling for the serial input data originating from the NSRAAM CTU is shown in Figure 12.

Each interface channel shall consist of 8 wires (4 twisted shielded pairs). Output Data, Input Data, clock and synchronization signals are each transmitted differentially. Information on one line of a wire pair shall be the 1's complement of the other line. The word transmission shall be in a non-return-to-zero form. The bit transmission rate shall be 125 kHz. A minimum delay of two clock times is to be provided between successive sync signals to a CTU.

The serial, digital transmitter shall provide digital signals with the specified levels for differential transmission when terminated in a standard load of 2500 ohms ± 20% connected to 2.5 volts ± 10%, in parallel with 2200 pf maximum for clock or 3600 pf maximum for sync, Output Data and Input Data. The high level (logic 1) shall be between + 3.7 to +6.0 VDC supplying up to 5 ma. The low level (logic 0) shall be between 0 to + 0.9 VDC receiving up to 5 ma. The signal rise and fall time shall be 0.6 μs maximum for 55-ohm source and 1.2 μs maximum for 110-ohm source unless otherwise specified. The difference between the rise one line and the fall of the other shall be no greater than 0.1 μs.

The digital receiver shall receive digital differential signals with a high level (logic 1) of + 0.6 to + 6 VDC input difference and a low level (logic 0) of -0.6 to -6 VDC input difference. The signal pulse width shall be 0.7 μs minimum in either "one" or "zero", and the common mode voltage shall be + 5 VDC maximum with respect to ground. The receiver shall indicate a logical "zero" with both input lines disconnected.

OUTPUT DIGITAL DATA TO NSRAAM CTU

OUTPUT DATA WORD	BIT POSITIONS	SIGNAL NAME	LOGIC CODE/SCALING
0000	1	Not Used	Logic 0
0000	2-5	Word ID	BIT 5 4 3 2 0 0 0 0 = Word Zero
0000	6	Tactical	Logic 0 = Test Data Logic 1 = Tactical Data
0000	7-18	J Direction Cosine	BIT 18 17 16 7 0 1 1 - - - 1 = +1 0 0 0 - - - 0 = 0 1 0 0 - - - 0 = -1
0000	19-30	I Direction Cosine	BIT 30 29 28 19 0 1 1 - - - 1 = +1 0 0 0 - - - 0 = 0 1 0 0 - - - 0 = -1
0000	31	Parity	Logic 0 or 1 for Odd Parity
0001	1	Not Used	Logic 0
0001	2-5	Word ID	BIT 5 4 3 2 0 0 0 1 = Word One
0001	6	Tactical	Logic 0 = Test Data Logic 1 = Tactical Data
0001	7-13	Spare	Logic 0
0001	14	Fire	Logic 0 = Fire Event Not Logic 1 = Fire Event
0001	15	CSAS	Logic 0 = CSAS Inhibit Logic 1 = Corridor Scan
0001	16-17	Cage/Slave/Track (M1, M2)	M1 M2 BIT 17 16 1 X = Cage 0 1 = Slave 0 0 = Track Enable
0001	18	NSRAAM Select	Logic 0 = NSRAAM Not Select Logic 1 = NSRAAM Select
0001	19-30	K Direction Cosine	Bit 30 29 28 19 0 1 1 - - - 1 = +1 0 0 0 - - - 0 = 0 1 0 0 - - - 0 = -1
0001	31	Parity	Logic 0 or 1 for Odd Parity

FIGURE 11

INPUT DIGITAL DATA FROM NSRAAM CTU

INPUT DATA WORD	BIT POSITIONS	SIGNAL NAME	LOGIC CODE/SCALING
0000	1-5	Not Used	Logic 0
0000	6-8	Not Used	Logic 0
0000	9-17	Seeker J Direction Cosine	BIT 17 16 15 --- 9 0 1 1 - - - 1 = +1 0 0 0 - - - 0 = 0 1 0 0 - - - 0 = -1
0000	18-20	Not Used	Logic 0
0000	21-29	Seeker I Direction Cosine	BIT 29 28 27 --- 21 0 1 1 - - - 1 = +1 0 0 0 - - - 0 = 0 1 0 0 - - - 0 = -1
0000	30	Parity	Logic 0 or 1 for Odd Parity
0000	31	Parity Check	Logic 0 = Incorrect Parity Logic 1 = Parity
0001	1-5	Not Used	Logic 0
0001	6-11	Spare	Logic 0
0001	12	Seeker Ready	Logic 0 = Seeker Not Ready Logic 1 = Seeker Ready
0001	13	Preamp Gain	Logic 0 = Not Switched Logic 1 = Switched
0001	14	Angle Coincidence	Logic 0 = Not Angle Coincidence Logic 1 = Angle Coincidence
0001	15	Target Lockon	Logic 0 = Not Lockon Logic 1 = Lockon
0001	16	Target Detect	Logic 0 = Not Target Detect Logic 1 = Target Detect
0001	17	NSRAAM Onboard	Logic 0 = Not Onboard Logic 1 = Onboard
0001	18-20	Not Used	Logic 0
0001	21-29	Seeker K Direction Cosine	BIT 29 28 27 --- 21 0 1 1 - - - 1 = +1 0 0 0 - - - 0 = 0 1 0 0 - - - 0 = -1
0001	30	Parity	Logic 0 or 1 for Odd Parity
0001	31	Parity Check	Logic 0 = Incorrect Parity Logic 1 = Parity

FIGURE 12

The avionics shall provide to the CTU standard aircraft power. The power form shall be 115 VAC, 400 Hz, Y connected 3 phase capable of providing up to 5 amps per phase. All electrical power shall conform to MIL-STD-704A, Category B.

A separate 115 VAC power return line, isolated from the CTU frame ground line in the CTU, shall be provided between the CTU and the launcher where each is tied to launcher frame ground.

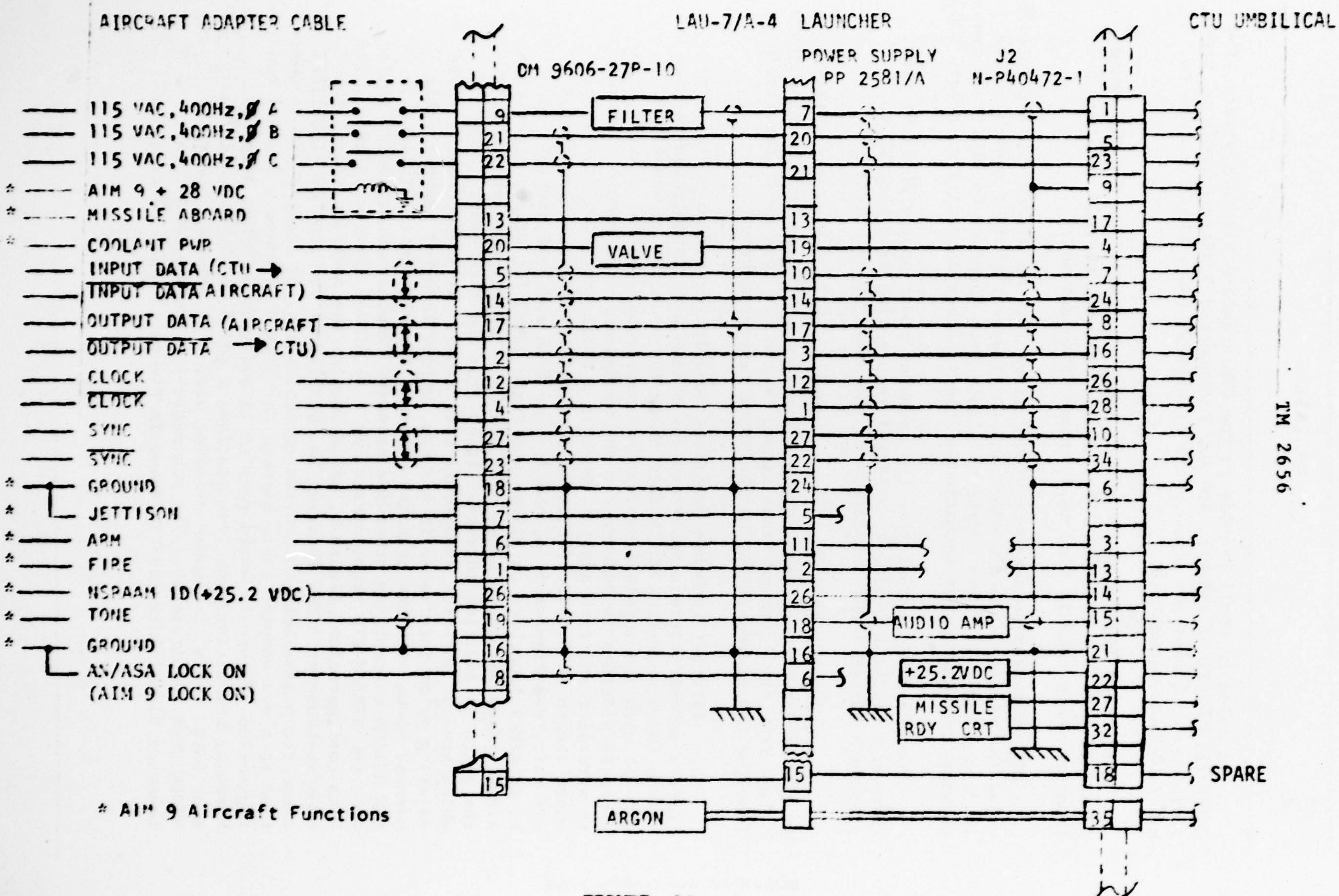
CTU will provide separate ground lines for the aircraft power interlock relay (or missile aboard sensor) and the launcher coolant control valve (0.75 amp nominal). Two additional lines from launcher to CTU frame ground, prevent the inadvertant actuation of the launcher motor firing relay, K303.

The +25.2 VDC output from the launcher power supply shall be tied, through a blocking diode, to a signal return line from the CTU to provide a NSRAAM IDENT indication to the aircraft avionics.

A seeker tone line shall be provided to the avionics for utilization by the aircrew member as an audio indication of the seeker tracking state. A line from the launcher frame ground to the CTU tone generator, isolated from the CTU frame, serves as the input reference base.

b. Aircraft Launcher Interface Description - Each of the aircraft armament stations specified for NSRAAM CTU installation possess common characteristics which facilitate the usage of an unmodified LAU-7/A with its internal coolant gas supply and control valve. Each aircraft provides an adapter for the mechanical interface of launcher to aircraft; and each adapter requires a cable harness of relatively short length to provide for the electrical interface of launcher to aircraft, see Figures 5, 6, and 7. The F-14 and F-15 aircraft mount their AIM-9 launchers on pylons which are wired for stores other than AIM-9. Each has three phase 115V 400 Hz aircraft power available at the pylon in addition to signal lines from the fire control computer which are not normally associated with AIM-9. By incorporating these existing pylon interfaces into a new, unique launcher adapter cable harness along with the standard aircraft AIM-9 circuits utilized in the NSRAAM concept, an otherwise standard launcher installation satisfies the NSRAAM CTU requirements for F-14 AIMVAL captive flights. The F-15 configuration, Figure 6, would require the modification of the Adapter-Launcher AIM-9 (Drawing No. 68A731326) for another electrical connector access hole to provide compatibility for the LAU-7/A in addition to a new adapter cable harness for NSRAAM carriage. The A-7 configuration, Figure 7, would require in addition to a new adapter harness, new wiring runs from stations 4 and 5 to the avionics/equipment bays. This is because existing wiring is limited to early SIDEWINDER requirements. The schematic for the NSRAAM Aircraft/Launcher Signal Interface is shown in Figure 13. The correlative

NAVY SRAAM AIRCRAFT/LAUNCHER SIGNAL INTERFACE



* AIM 9 Aircraft Functions

FIGURE 13

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NSRAAM CTU/Launcher Signal Interface is shown in Figure 8. The CTU three phase 115V 400Hz aircraft power source and the digital data signal line routings through the aircraft must be determined individually for each aircraft. The signals identified as AIM-9 Functions are currently available at each aircraft armament station specified (with the exception of the Identification Signal line in the A-7). Their usage and/or control would remain unchanged except for jettison and AN/ASA AIM-9 Lock-On which are not wired into the aircraft end of the adapter and are grounded at the launcher end.

The three phase power interlock relay shown as part of the adapter cable in Figure 13 is in addition to the AIM-9 power interlock relay mounted in each aircraft which also serves as Missile Aboard Indicator initiator for the F-15 and A-7. Simultaneous power would be delivered to the launcher when the CTU umbilical was mated to the launcher, or when the auxiliary three phase power relay is actuated subsequently.

The inherent direct current counterflow properties of the Missile Aboard (Power Interlock) and the Missile Identification signals in the launcher is utilized by interchanging these functions for NSRAAM with respect to AIM-9 usage. Blocking diodes in the ID circuits of both AIM-9L and CTU would not permit the respective power interlock relay to close if the "wrong" store was to be inadvertently loaded and the ambilical coupled to the LAU-7/A. The Missile Aboard Indicator would not be initiated and the ID would be launcher ground.

CTU/AIS POD DATA REQUIREMENTS

The aircraft avionics interface unit (AIU) shall provide the NSRAAM CTU data to be transmitted to the AIS pod. The AIS pod shall control the transmission of the serial digital data from the AIU to the AIS pod by providing: (1) a clock signal, (2) a data sync signal, and (3) an input data signal. The CTU data transmitted shall be contained in the 96 bit word received by the AIS pod Digital Interface Unit (DIU).

The CTU data transmitted to the AIS pod, before lock-on, shall be the data from the seeker of priority as determined by the avionics CTU Acquisition priority computation. After lock-on, the CTU data transmitted to the AIS pod shall be from the seeker which is in the track mode.

CTU data items to be transmitted to the AIS pod are as follows:

NUMBER OF BITS	TYPE	INTERPRETATION
12	I Direction Cosine	CTU LOS drive input data prior to lock-on. (Aircraft reference frame)
12	J Direction Cosine	CTU LOS drive input data prior to lock-on. (Aircraft reference frame)
12	K Direction Cosine	CTU LOS drive input data prior to lock-on. (Aircraft reference frame)
9	Seeker I Direction Cosine	Seeker LOS output data. Valid only after lock-on. (Aircraft reference frame)
9	Seeker J Direction Cosine	Seeker LOS output data. Valid only after lock-on. (Aircraft reference frame)
9	Seeker K Direction Cosine	Seeker LOS output data. Valid only after lock-on.
2	Station Select	A two bit binary code indicating which seeker has locked on.
1	Weapon Select	A discrete binary bit indicating the NSRAAM has been selected.
1	Weapon Release	A discrete binary bit indication that the trigger has been depressed.
1	VTAS Data Valid	A discrete binary bit indicating that the VTAS data is valid.

NUMBER OF BITS	TYPE	INTERPRETATION
1	Angle Coincidence	A discrete binary bit indicating that the seeker has angle coincidence with the aircrewman's LOS.
2	Cage/Slave/ Track Mode	A two bit binary code indicating the CTU seeker command mode logic (M1, M2).
1	CSAS Mode	A discrete binary bit indicating the CTU is being used in the corridor scan mode.
1	Target Detect	A discrete binary bit indicating the seeker has detected a target in the FOV.
1	Target Lock-On	A discrete binary bit indicating the seeker is tracking a target.
1	Preamp Gain	A discrete binary bit indicating the seeker has switched from low level target to high level target.
1	Coolant On	A discrete binary bit indicating that the seeker detector is being cooled.
1	Fire Event	A discrete binary bit indicating the CTU has been launched.
1	Radar Mode	A discrete binary bit indicating the Radar Mode has been selected.
1	Seeker Ready	A discrete binary bit indicating the seeker detector is cooled to operating temperature and all CTU voltage forms are present.

79 = TOTAL REQUIRED