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SUBJECT: AUTOMATIC TRACKING SYSTEM TRANSFER FUNCTION

To: Assembly Test Support

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Abstract: This document contains a compilation of all general information comprising the present tracking subpackage. It builds up from inputs through individual programs and then to finally checking the compatibility of programs on a system basis. Diagrams show major flows through the subpackage, a set-used deck indicates effects, a glossary develops tracking terminology and table breakdown gives relative placement. Simplified mathematical specifications set up a logical basis of development.

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OUTLINE

Automatic Tracking System Transfer Function

Automatic Tracking Function

1.0 Introduction

The Automatic Tracking function, receives the majority of its inputs from the outputs of the Radar Input Function, which immediately precedes the AT function in the DCA System.

Three phases compose the AT Function:

A. Initiation Phase

B. Automatic Tracking Phase

C. Bookkeeping Phase

Tracks are selected from two (2) initial pickups meeting the criteria of distance involved (Automatic Detection), then this new tentative track, through correlation of radar data, becomes established (Initiation Phase). The track is then automatically maintained as established, or due to difficulty manually monitored (Automatic Tracking Phase). Throughout the period that the track remains within the system, records are maintained (Bookkeeping Phase).

1.1 Initiation Phase

Tracks are detected automatically by the computer program and manually by five (5) Track Initiators. The Track Initiators are under the supervision of the Initiation Supervisor, who also has charge of the Area Discriminator. The Area Discriminator is a device used to specify areas in which initiation will be performed by the computer, the other areas assigned to the

Track Initiators. The culmination of the initiation phase occurs when the track is either established or emptied.

1.2 Automatic Tracking Phase

This phase is mainly performed by the computer program with operating personnel affecting the process through the performance of other related functions such as track monitoring. The first concern of the tracking function is the automatic processing of search and mark X radar data to determine positions and velocities for tracks within the subsector surveillance area. It also may process certain crosstold and manual-input tracks. It does not process any raids or groups made up from tracks for summary purposes, or any tracks crosstold to the subsector for warning purposes.

A tracking status is associated with each track to inform the automatic tracking and Bookkeeping functions of the type of processing required for a particular track

1.3 Bookkeeping Phase

The bookkeeping phase operates on all tracks in the system mainly sensing for changes in status or identity to perform the correct bookkeeping function. This phase can assign track numbers, automatically identify tracks as pending or friendly, drop tentative tracks, place certain tracks in drop cycle to make room for delayed interceptors, clear tables on

old drop cycle tracks, perform summary counts, turn on alarm indicators, make up tabular messages, and maintain five minutes of history on all active tracks.

Tracks are selected from many initial pickups becoming associated with each other (Initiation Phase) then the automatic tracking phase tries to correlate radar data with the track, (Correlation) and then compute estimates of velocity and position for these tracks (smooth & predict process). On certain type tracks such as manual-input, lost, dead reckon, extrapolated, the AT function estimates new positions on the basis of the last known velocity or assigned velocity (dead reckon). The AT function also removes certain tracks from the system automatically. Certain radar data situations arise that make it impossible to continue tracking a particular aircraft automatically. Thus we request assistance from track monitors. During the smooth and predict process the smoothest curve through all past and present data is derived. Two types of tracking evolve from this smoothing. The first is straight line tracking which indicates that during the frame we receive information within the small search area of the predicted position indicating a relatively constant straight movement. The second type will refer to the non straight movement or the change in direction type. This refers to the

failure of data appearing within the small search area thus indicating a change in direction, if found within the large search area.

The smooth and predict process is done on a subframe basis for indications of straight line tracking. This sampling takes advantage of the triple coverage of multiple radars. The change of direction tracking occurs on a frame basis in order to allow sufficient time for data accumulation and th e decision is delayed long enough to give an accurate appraisal of the situation.

2.0 Description of Programs within AT Function

2.1 Programs in the AT Function

Program	Name	DCA Index	Mod
STK	Track Situation Display	5.3.2	27
KST	Switch Interpretation TO-TT	5.5.2.3	22
KSI	Switch Interpretation Initiation	5.5.2.4	38
CTS	Central Group Track Sort	5.1.3	35
TCO	Correlation	5.6.3	23
TSA	Smooth & Predict	5.6.4	10
TSD	Smooth & Trouble Detection Dead Reckon	5.6.5.4	9
TSE	Smooth & Trouble Detec-	5.6.5.1	21

Program	Name	DCA Index	Mod
	tion Established Tracks		
TST	Smooth & Trouble Detection Tentative Tracks	5.6.5.3	6
CTA	Central Track A	5.1.2.1	33
CTB	Central Track B	5.1.2.2	17
CTH	Track History Makeup	5.1.2.5	13
TNC	Track Number Conversion System Subroutine	5.1.2.4	11

2.1.1 (a). KSI 5.5.2.4 Mod. 38 (Switch Interpretation Program) for IS & TI By Light Gun or Activate action in conjunction with switch inserted information KSI furnishes a basis for operation of other programs both within and without the tracking package. A request for display can be transmitted to a display program. A track can be initiated with an inactive status which limits further action until CTA can operate. Finally a tentative track can be made established. These actions produce a situation in which TCO and TSA or TSE can function.

(b) KST 5.5.2.3 Mod 22 (Switch Interpretation Program) for TO & TT By Light Gun or Activate action in conjunction with switch inserted information KST fur-

nishes a basis for operation of other programs both within and without the tracking package. A request for display can be transmitted to a display program. A track can be placed in a drop cycle for action by CTA. Finally a track can be initiated and given a status of established for further action by TCO and TSA or TSE.

2 1.2 Program Description of CTS

2.1.2.1 From the Track Positions, Track Statuses, and Dead Reckon Indicators, CTS will construct the Track Sort Table (SRTØ). This table will contain the relative position of the track with reference to the "Sort Box System", the status of the track, and an indicator bit which tells TCO whether or not to attempt correlation on the track. By grouping the tracks into sort boxes, CTS saves TCO the trouble of searching thru the whole of Track Data Central to find the tracks that could possibly correlate with a given radar return.

2.1.2.2 CTS will set an indicator as an aid in the correlation process when there are two tracks, with statuses of established, tentative or correlating crosstell, whose large search

areas overlap.

2.1.2.3 CTS will also drop tentative tracks when they are within 2 miles of a track whose status is established or correlating crosstell.

2.1.2.4 CTS will construct the sort table for those tracks whose statuses are active only. The correlation indicator will be set for those tracks whose statuses are established, tentative or correlating crosstell only.

2.1.3 TCO - Correlation 5.6.3

Each subframe, TCO correlates all returns (tape, drum & MSG) with tracks. All returns for the subframe are transferred to the R.D. display drum as either correlated or uncorrelated, and MKX or non-MKX. On the RD drum, a return is not identifiable in terms of subframe received; GFI or SER site; site identity; drum, tape, or MSG source.

2.1.4 TSA Mod. 10

Smooth, position and velocity, predicts position for all tentative and established tracks which have correlated data in the small search area.

Predicts position for all tentative, established, correlated crosstell, dead reckoned, lost and airborne

which have a track status change with no delay.

Detects split tracks which have correlated data in small search area and have a track status of tentative or established and predicts a new position for the split track.

TSPI is set by TSA indicating a split track. This item is then used by CTS.

TSRG is set by TSA when a split occurs indicating rapid change of track symbology which effects STK.

2.1.5 (a) Mod 09 TSD Predicts Position and Velocity for Airborne, lost, non corr. x-tell, extrapolated and manual input tracks. The system will not attempt correlation with these tracks and they will be predicted ahead on the basis of their past position and velocity except for interceptors which are predicted on their command heading and speed.

(b) TSE - Track Smooth and Trouble Detection - Established Tracks. D.C.A. 5.6 5.1 Mod 21

The purpose of this program is to smooth position and velocity of established tracks that had good distribution of correlated data within the large search area. Also, to determine the tracking merit of the track, change to lost the status of tracks with a history of

poor tracking merit, determine the existence of track trouble and the type of trouble and determine the need for monitoring action. In addition, a count of Mark X radar data correlation with the track is maintained, a Mark X status determined from the above count, and the existence of any Mark X emergency replies to be communicated to the Tracking Officer. A history for each track is kept for any, poor distribution in the past frame, the areas in which radar data was correlated in the past frame, the existence of tracking trouble in the past two frames, a count of consecutive frames of poor tracking merit, and a count of simulated data correlated with real tracks per pair of frames.

(c) TST Mod 06 Smooths & Predicts position and velocity of tentative tracks with data correlating in the large search area and will automatically establish or empty these tracks.

When TST empties out a track it clears all central track bookkeeping tables. Summary facts affect the bookkeeping programs CTA, CTB, CTH and STK (a situation display program).

If TST sets the track to inactive establish, CTA will

activate the track, STK will change symbology, and CTH will correct the history.

2.1.6 (a) CTA 5.1.2.1 Mod. 33 Central Track A - A Class

CTA maintains and upgrades track status and track identity change indicators and maintainers. Once a track status or identity has been changed, this program will count the no. of subframes since these items were changed for three subframes and then will reset these counters to zero.

If a track has been in drop cycle for three subframes, then CTA actually drops the track from the system by deassigning the track no. and availability bit, clearing the Track No. Storage table and clearing Track Data Central.

If CTA finds an empty channel or actually empties a channel itself by dropping a track, it will activate any delayed interceptors by taking the data concerning the delayed interceptors from the CDI table and setting it into the empty channel. It also will assign a track No., a status of either scrambled or airborne, and identity of interceptor and various other items. If the number of delayed interceptors is

greater than the sum of the empty channels and the no. of tracks in drop cycle, the program will place enough friendly, pending or faker tracks in drop cycle and/or actually drop enough tentative tracks to take care of the remaining delayed interceptors.

CTA changes the status of new tracks in the system from inactive to active so they can be worked on by the tracking programs. If the track has not already been assigned a track no., CTA assigns one and also an availability bit in either the NAV or FAV tables for newly established tracks. It will attempt to automatically identify it as friendly. If unsuccessful, it will give the track an identity of pending.

Redesignated and specially designated interceptors are processed by this program by assigning and de-assigning track nos. as needed.

CTA keeps a count of the no. of unassigned and deferred HUK tracks and also the no. of extrapolated HUKS. If either of these counts are greater than a set limit, an alarm is set. An alarm is also set if a track was put in drop cycle to make room for a delayed interceptor.

Other counts kept for the digital display programs are

the no. of interceptors, no. of HUSI, no. of tracks in drop cycle, no. of tracks in the system and the no. of empty channels.

New Warning Cross Tell Track nos. and New Raid/ Group Track nos. are set into Track No. Storage Table. Any new track nos. assigned by the program are set into TNS along with their channel no. If a track no. is deassigned, the appropriate register in TNS is cleared. This table is also sorted by track no. The nos. are placed in descending order in the table.

(b) TNC (Track No. Conversion) DCA No. 5.1.2.4 Mod 11

Track number conversion (TNC) searches track number storage (TNS) for the channel number of a given track number, and exits with these in the accumulators for use by the requesting program. The track number storage location will be located in the right B register for use by CTA when it clears out a certain TNS register from drop track processing.

The following programs use TNC as a sub-routine.

CTA TCO KSI KST

KSI KST and TCA enter for the channel number.

2.1.7 (a) CTB Central Track B: DCA No. 5.1.2.2

CTB scans Track Data Central and performs inventory sum counts once per frame on the various classes of tracks being carried in the system. The tracks are subdivided by track status, track identity, and several other breakdown criteria for counting purposes. In addition, CTB calculates 6-frame sum count averages once per frame and maintains a history of them for the last six frames on the following:

a. Average No. of tentatives

b. Average No. of tentatives dropped

c. Average No. of tentatives established

d. Average No. of unused initial pickups

e. Average No. of rejected initial pickups

CTB steps the track age and track altitude age counters once per frame up to their maximum values. It also senses for an initial-pickup overload alarm and communicates to digital display via a communication register whenever initial pickups exceed the maximum limit per frame for any 3 consecutive frame period.

(b) CTH (Track Hist. Makeup) DCA No. 5.1.2.5 Mod. 13

Track History Makeup. (CTH) makes up a track history showing changes in position, altitude, Mark X

status, track merit symbology and track status.

Most of the history is made from data computed by the programs in the tracking package.

The following programs in the package set the items which are used for display.

Altitude (TALT)	
Position (TPOS)	KSI, KST, TSA, CTA, TSE, TSD, TST
Tk. Status (TSTS)	KSI, KST, TSA, CTA, TSE
Mk. X Status (TMXS)	TST, TSE
Tr. Merit (TRMT)	KSI, KST, CTA, TSE, TST

If there is no past history on a track the original values are used as data for the history table. If there is a past history the changes are computed from previous data and used as new data for the tracks history.

Track History indicator is set by CTA when it activates a delayed interceptor and CTH will set the new data in for the interceptors history and set the TRH indicator to show that there is now a history. CTH starts the history in the second subframe and runs once a minute. (Class C Program)

No history is made for inactive or drop cycle tracks.

The history is stored in the TRH table for use by SSH

(5.3.6.2)

2.1.8 STK - Track Situation Display 5.3.2 Mod 27

The STK program monitors the tabular message drum layout and affects the following changes. Once each subframe, if necessary, the program relocates tracks moved by switch action, up-dates track symbology, changes the category routing of tracks to consoles, and changes display assignment bits. It also turns off certain change bits, deposits the Display Assignment Bit message into the track message of each track, and turns off the display of inactive tracks or tracks out of the times one display.

Once each frame the program updates the symbology for track age, suspicious friendlies, interceptor distance to target and target bearing, and track velocity and position on the display.

3.0 The AT function is necessarily dependent upon the Radar Input Functions and its generated outputs. External outputs are defined as those outputs, such as displays, which occur due to the function and are transmitted outside the computer. Internal outputs are generated by the function and continued within the computer and its environment.

3.1 <u>External Outputs</u>

Each subframe all MSG - Tape and Drum returns, which have not been rejected by TRI, are stored for display on the RI Display Drum. Each frame the RD scan counter is stopped, and one frame of data is displayed brightly as last frame.

3.2 Internal Outputs

a. Drum, tape and MSG Data are converted to one X, Y frame and transmitted to the AT functions each subframe for correlation with tracks.

b. Simulated keyboards and light guns (read from magnetic tapes) are stored in place of live keyboards and light guns each subframe.

4.0 External and Internal Inputs into the AT function

Most of the external inputs are received from the outputs of TRI, which are placed into the ATAØ, 1 table by PEC.

4.1 External Inputs

There are three types of radar information TCO handles.

A. Real-time simulated data from the MSG program which places this information in the ATSØ table.

1. ATSØ (Automatic Tracking Simulated Peripheral Table) provides the link between MSG and TCO.

a. Length: TCAP, plus 3 regs.

b. Capacity: 3 control words plus a number of one-word radar returns equalling track

capacity.

c. A master control word appears in the first register denoting starting address and no. of words to be read.

d. Two set control words, one each for SER and MKX returns will immediately precede the block of returns they govern. Format: radar type indicator; Sim indicator; Site ID; and no. returns in block.

e. Each one-word will contain the X and Y coordinates of the radar return, quantized to 1/4 mile.

B. Tape simulated data which is read off tapes by CMT and processed by TRI and in RIP2. PEC takes this information from the RIP2 table and places it in the ATA table.

C. Live Radar data read from the radar drums and processed by TRI and placed in the RIP2 table. PEC takes this information from RIP2 table and places it in the ATA table.

1. ATAØ (Correlation Radar Returns)

Serving as the link between TRI & TCO.

Format: Identical for all 2-word returns from each site are grouped under a set control word.

a. Set control word will contain: radar type,

sim. indicator, site ID, and number of 2-word returns.

b. Return will include: Sin ∅, slant range R; Cos ∅, extrapolation time, X and Y coordinates.

c. The final word in ATA will contain full zeros denoting the cut-off point for TCO. This word being the word following the last radar return to be correlated.

ATS∅ TABLE

LS 1	2 3	SET 8	CONTROL WORD 21	31
(1)	(2)	(3)	SPARE	SPARE (4)

1) Type of Radar-MKX equals zero, LRI equals 3

2) Simulation Indicator - 1 equals sim

3) Site Number

4) Number of returns

ONE WORD RETURNS

LS	RS
X scaled 1/4 mile	Y scaled 1/4 mile

ATA TABLE

Set Control Word

LS	L1	L2	L3	L9	RS	R15
(1)	(2)	(3)	SPARE		(4)	

1) Radar Type - LRI, MKX or GFI

2) Simulation Indicator

3) Site Identification - LRI & MKX - Ø - 9

GFI Ø - 14

4) Number of 2 word radar returns

2 Word Radar Return

#1

LS	L1	L5	L6	L15	RS	R1	R5	R6	R9	R10	R11	R15
+ -	Sine ⊖		Slant Range		+ -	Cos ⊖		Spare		+ -	Extra-pola-tion time	

#2

X scales 1/32 mile	Y scaled 1/32 mile

In the "A" subframe TCO checks to see if there is any real-time simulated data (MSG). If it finds real-time simulated data it attempts to correlate with existing tracks in the system. There is no data rejection by TCO, since both

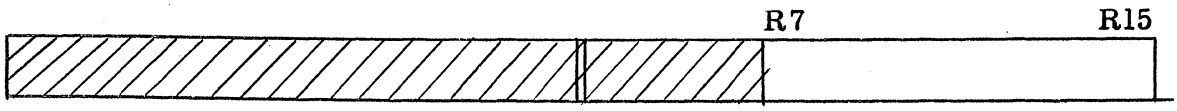
correlated and uncorrelated returns continue on to the RD drum. Each return is connected to the one word RD display message and placed in the RDP table.

If no real-time simulated was found TCO branches to PEC to allow it to transfer in the first block of the ATA table which contains either type simulated or line radar data which was processed by TRI. TCO now attempts to correlate these radar returns with existing tracks. This return is now converted to the one word RD display message and placed in the RDP table. TCO continues to process the returns found in the ATA table until all returns have been processed which is indicated by a full zero control.

RDP table consists of two blocks of 425 regs. each. RDPØ and RDP1. This table stores display messages while awaiting transfer to the RD drum. The first reg. of each block will contain number of words to be read.

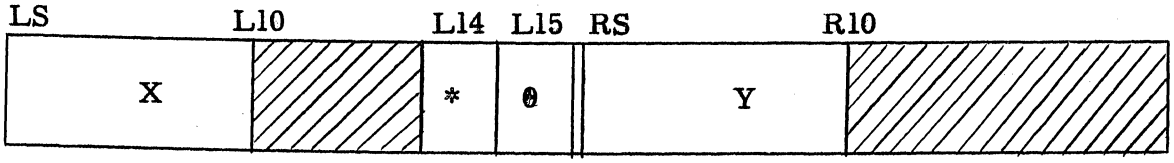
1. Length: 425 regs.
2. Capacity: 424 returns
3. Message Format: One word containing X and Y in display coordinates, a MKX indicator, and a correlation indicator.

RDP Word Layout



Control word indicating number of words to be read from this block.

Display Word Layout



* "1" MKX - "0" Non MKX

0 "1" Correlated, - "0" uncorrelated

TCO also checks to see if there is any correlation history requests by looking at the TRC1. If there is a request it places this information in the COR$\emptyset$ table which is used by the CRA (Recording) program.

Table Tag: COR

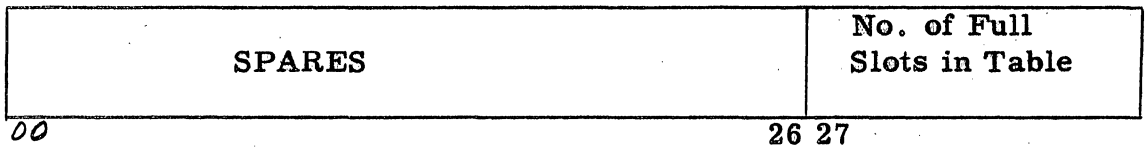
No. of Blocks: 1

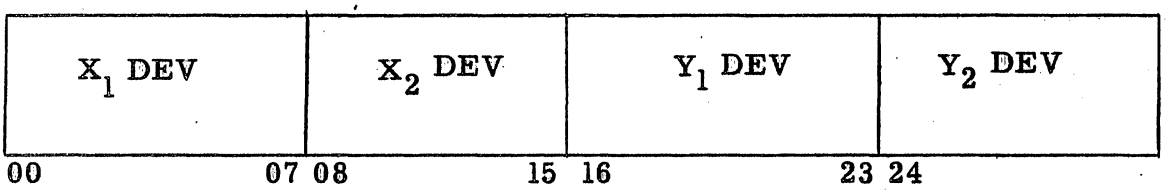
No. of Words per Block: 101

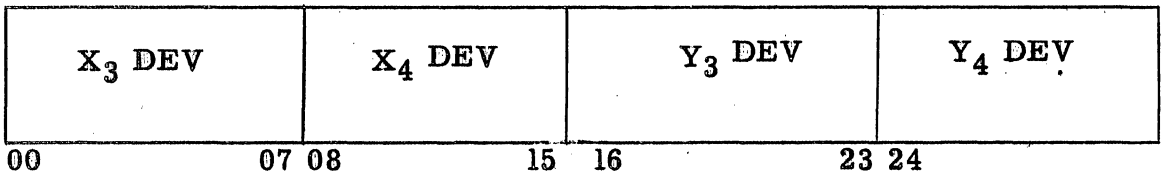
This table communicates from TCO to CRA correlation histories of a maximum of 20 tracks on which CRA is doing a correlation study. The first register contains the number of tracks represented in the table. The next five registers give the number of radar returns correlated with this track, the associated TCN, and the following information on the first five returns correlated with this track: X and Y deviations, age of data, set type and site identification. This five-

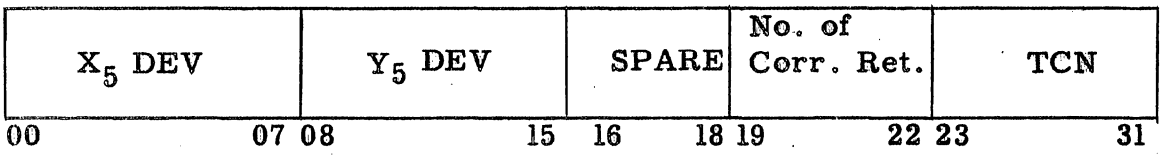
register format is repeated nineteen (19) times to provide for a maximum of 20 tracks.

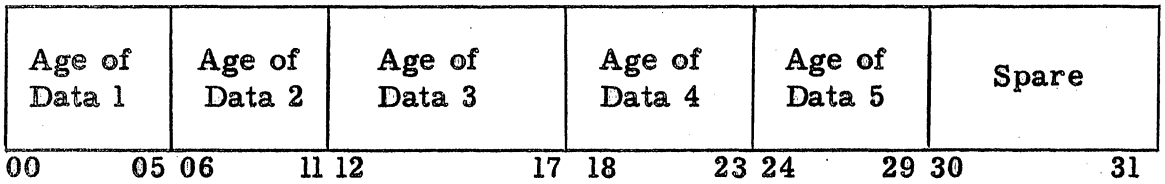
CORØ

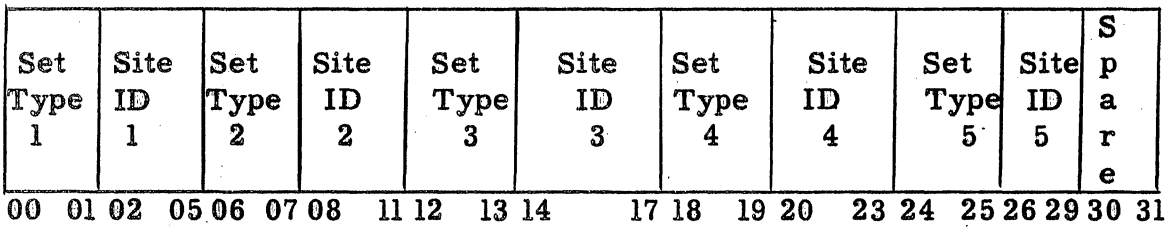












4.1.1 Actions by the eight persons concerned with the AT Function, Initiation Supervisors, Track Initiators (5), Tracking Officer, Tracking Technician.

By Light Gun or Activate action accompanied by switch insertions the eight persons may do:

L equals Light Gun A equals activate

IS - Initiation Supervisor

LG or A	Confirm a TNT track
LG	Initiate a M.I. track
LG	Initiate a Split track
LG or A	Attention TO, OT, or TI
A	Assign an Air Base
A	Air Base Assignment Summary DD
A	Initiation Summary DD
LG	Initiate with a TRN
LG	Initiate w/o a TRN

(4) TI - Track Initiators

LG or A	Confrim a TNT Track
LG	Initiate a Track
LG	Initiate an Interceptor
LG	Initiate an MI Track
LG	Initiate a split track

TO - Tracking Officer

A	Request Track History
A	Request Track Tote
LG or A	Attention TS 1 & 2, OT 1 & 2, IS
LG or A	Drop a Track
LG	Reinitiate a track

TT - Tracking Technician

A	Request a Track Tote

Operations specified in the Coding Specifications but not incorporated in Mod 22 of KST include:

TO

LG or A	Assign an OT or TS

TO & TT

A	Request an Initiation Summary
LG or A	Request a Track Summary
A	Request a Monitoring Summary
A	Request a Monitor Assgn. Summary
A	Request a Raid or Group Tote

TT

A	Activate/Assign all TM's of 1 Team
A	Activate/Assign all TM's of both teams
A	Activate/Assign one TS or TMS
A	Activate/Assign one TM
A	Deactivate a TS or TMS
A	Deactivate a TM

4.2 Internal Inputs

The Program TNC utilized as a subroutine sets up the relationship between track number and track channel and vice-versa.

5.0 PEC and PTM Effects

PEC initiates all in-out transfers of the programs contained in the Auto-Tracking Package together with their related, necessary environment. (A program unit is defined as a program which together with only a portion of its environment, can be contained in core storage at one time.) The beginning of a program unit defines a point at which a portion of the environment must be transferred into core in order to allow the program to work on that portion prior to bringing on the next portion of environment. The end of

a program unit defines that point at which the program has completed its utilization of that portion of the environment and now may transfer that portion of environment out of core storage. Each program unit in the Auto-Tracking Package is specified by a set of parameters in the PSP (Program Sequence Parameter) table. These parameters contain information used by PEC to determine if control should be branched to the program for that unit to operate, be delayed, or omitted.

PEC also refers to information concerning the individual transfers of environment for the Program units. This information is contained in the TSP (Transfer Sequence Parameter) Table.

When the time occurs for a particular program to work on a portion of its environment, the transfer of that portion of environment is made by reading from drums into core storage. During the program operation PEC may utilize the excess time to transfer more environment into core. After the operation of the program and its particular unit, that environment will be written from core storage back onto the drum from which it originally came. The program itself remains in core until such time as all the environment for that program is utilized. Programs are not read out from core into drums due to the program remaining on drums and having no destructive read-out. The next program plus its environment will then be read into core on top of the old program.

PTM is largely responsible for maintaining various clocks which are used by the program in the over-all Air Surveillance Package in determining when, in their sequence of operation they will perform functions that are executed only after a specific frame or subframe interval.

Within the Auto-Tracking Package there are three programs - KST, STK, TCO - which use item SFTC (Subframe Counter) which is set by PTM.

KST uses the item in computing the new position of a track after a re-initiation action has been taken by the Tracking Officer.

STK updates the position, velocity, track age and identity status of a track once a frame. It therefore must test SFTC to see if it is time to perform these functions.

TCO during the first subframe of every frame makes a test to check for data coming from the MSG program. If it doesn't find any, it branches control back to PEC to read in the ATA table. During the other two subframes TCO manipulates various masks for extraction purposes. It therefore uses SFTC to find out in which subframe it is operating.

PTM also sets items in the PTC table which indirectly affect programs in the Auto-Tracking Package. These items are conditionality indicators which dictate whether or not a program is to be operated. At present there is only one program in the Auto-

Tracking Package which is conditional; (i.e. CTH) PTM maintains a subframe counter for CTH; when it reaches the fourth subframe, or once a minute, PTM sets item CTHI in table PTC. PEC tests this item, and if it is on, it branches control to CTH. In this same manner, operation of the program KST may in the future be made conditional on an indicator in PTC.

5.1 Sequence of Program Operation

1st Subframe

PROGRAM	UNIT	
KSI	ØKIØ	
KST	ØKTØ	
TCO	ØTCØ	ESS
	ØTC1	
	ØTC2	
	ØTC3	
TSA	ØTAØ	
CTA	ØCAØ	
CTB*	ØCBØ	
STK	ØSTØ	

2nd Subframe

KSI	1KIØ
KST	1KTØ
CTS*	1CSØ

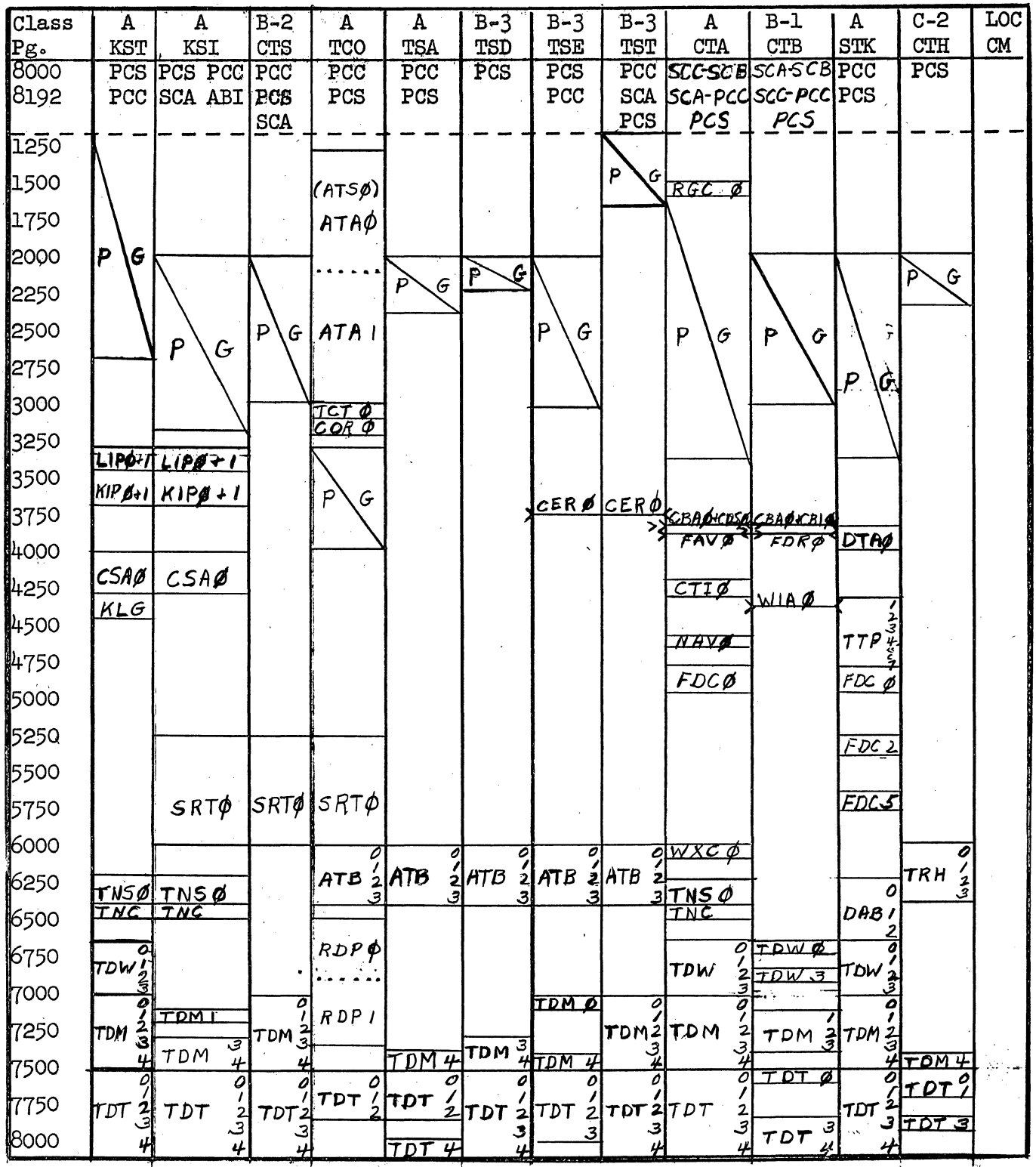
PROGRAM	UNIT	
TCO	1TCØ	
	1TC1	ESS
	1TC2	
TSA	1TAØ	
CTA	1CAØ	
STK	1STØ	
CTH**	1CHØ	
3rd Subframe		
KSI	2KIØ	
KST	2KTØ	
TCO	2TCØ	
	2TC1	ESS
	2TC2	
TSA	2TAØ	
TSD*	2TDØ	
TSE*	2TEØ	
TST*	2TTØ	
CTA	2CAØ	
STK	2STØ	

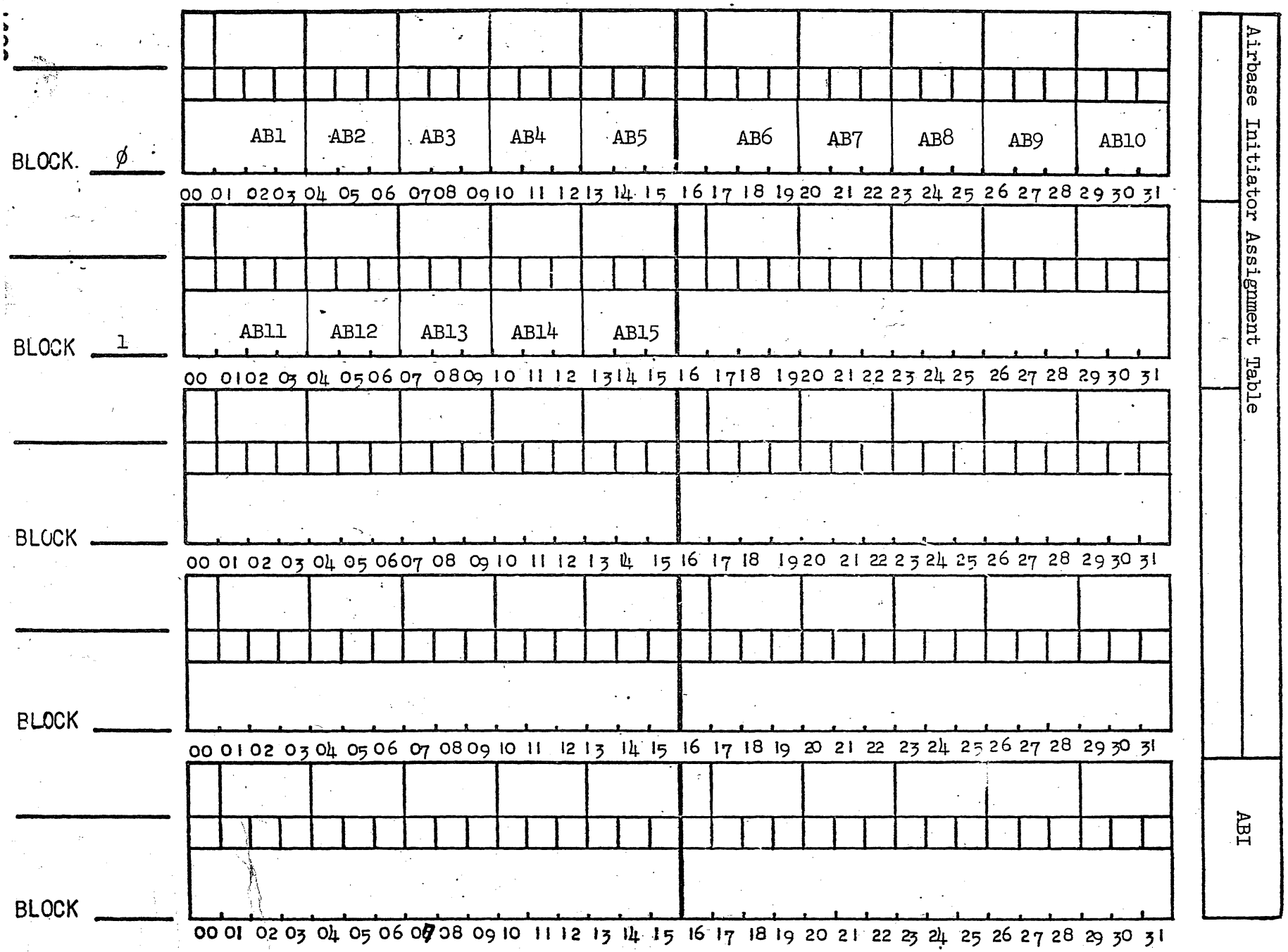
"A" Class once a subframe

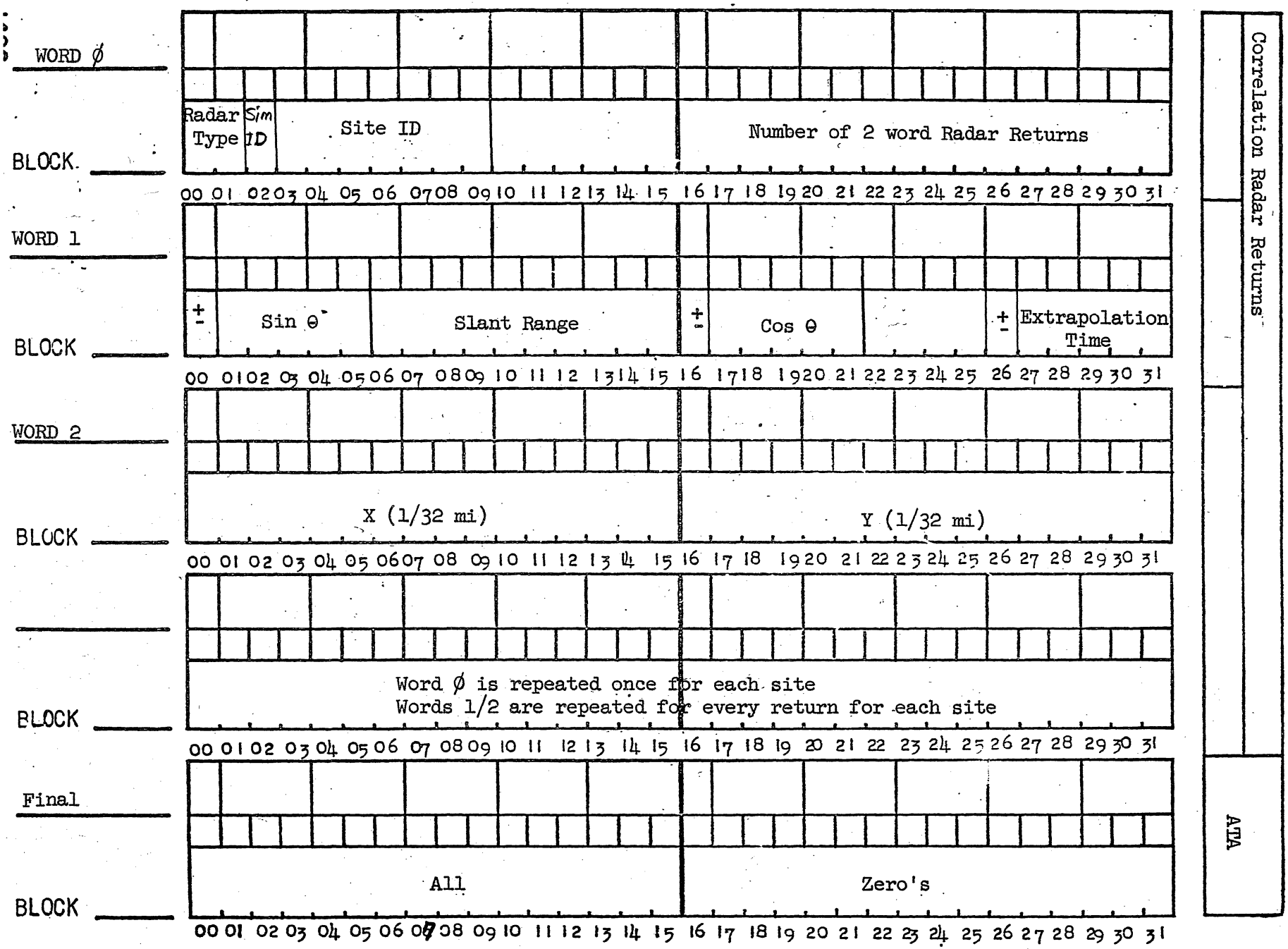
*"B" Class once a frame

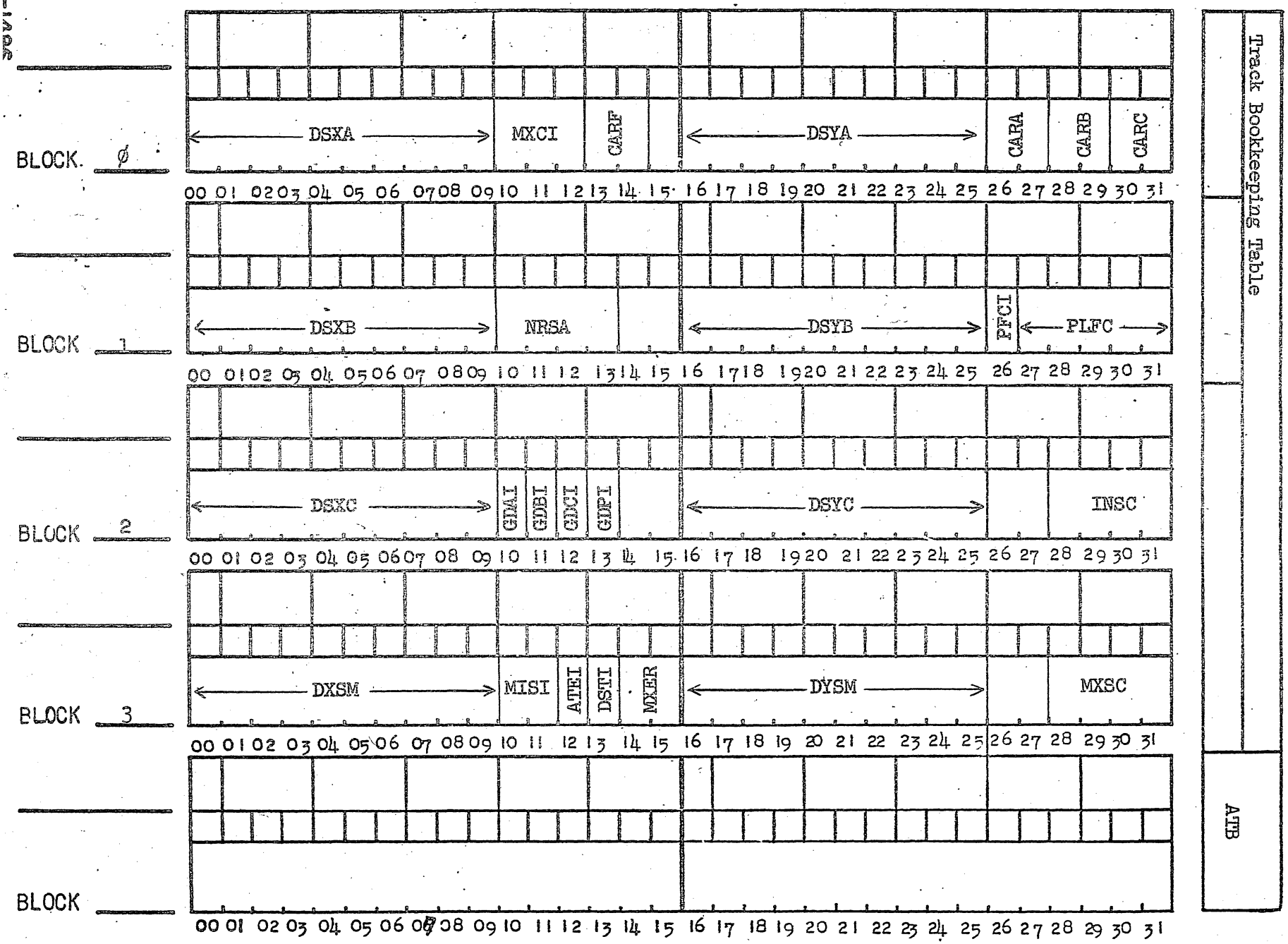
**"C" Class other than "A", "B"

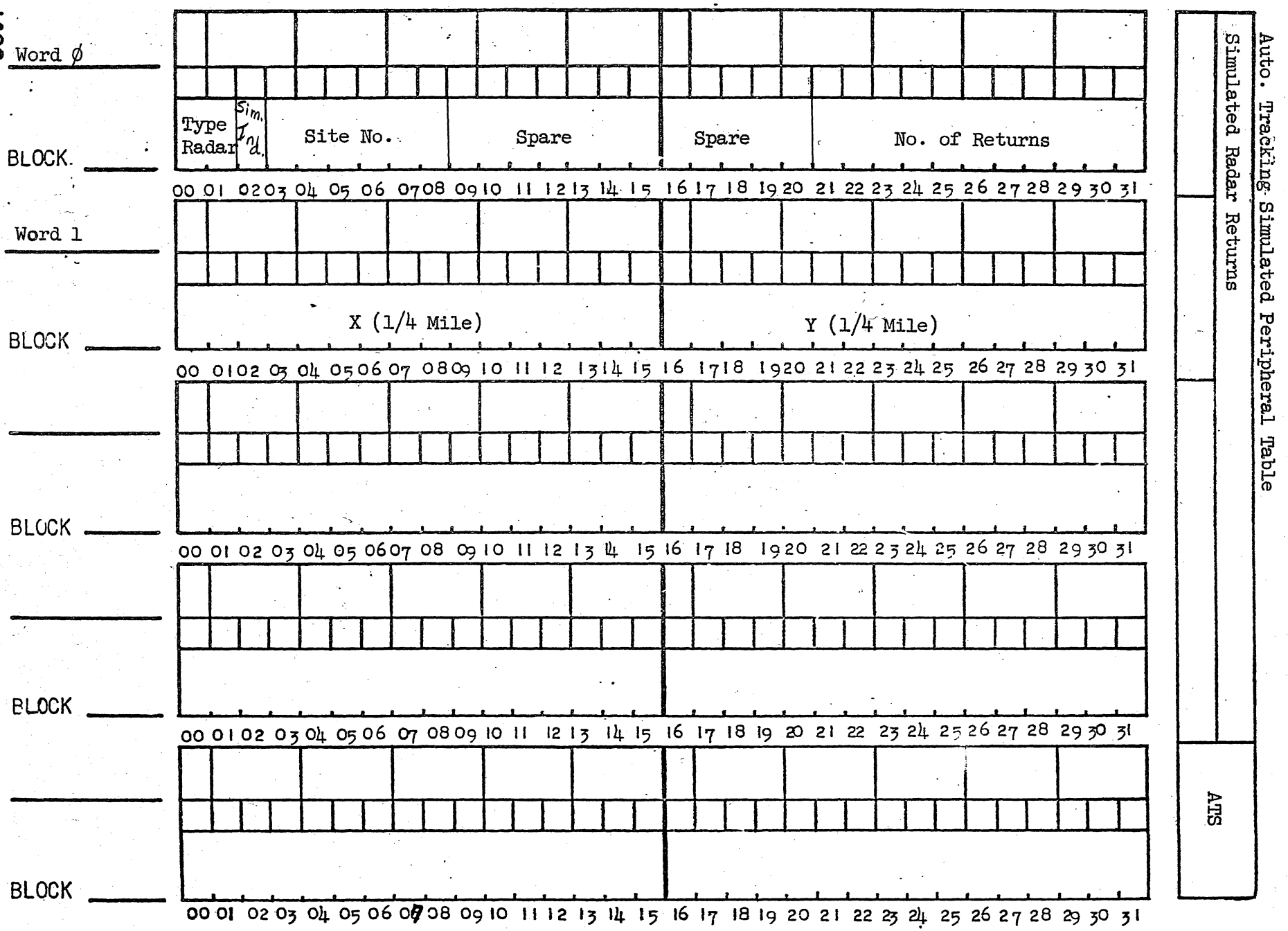
5.2 Package Environment

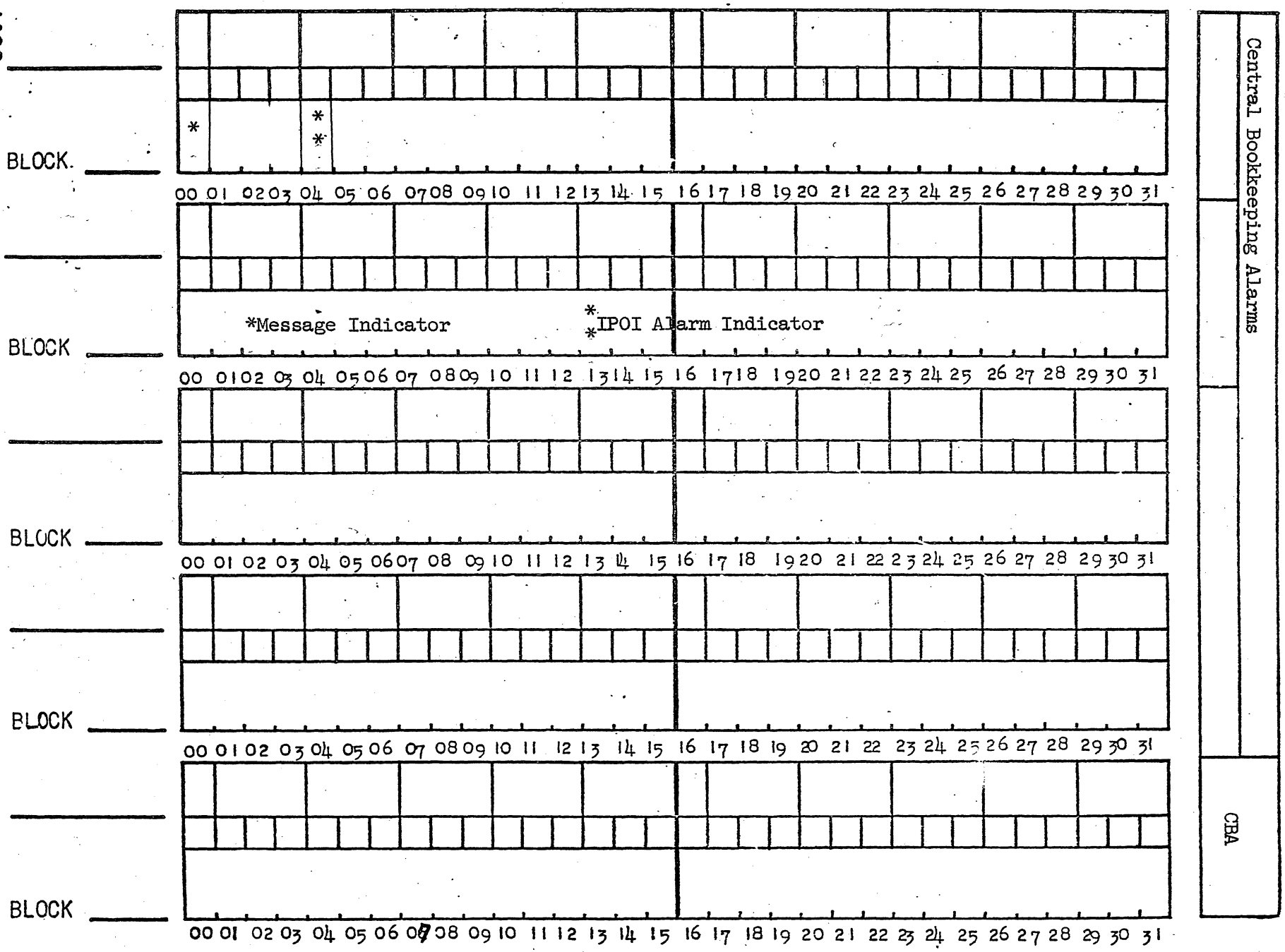


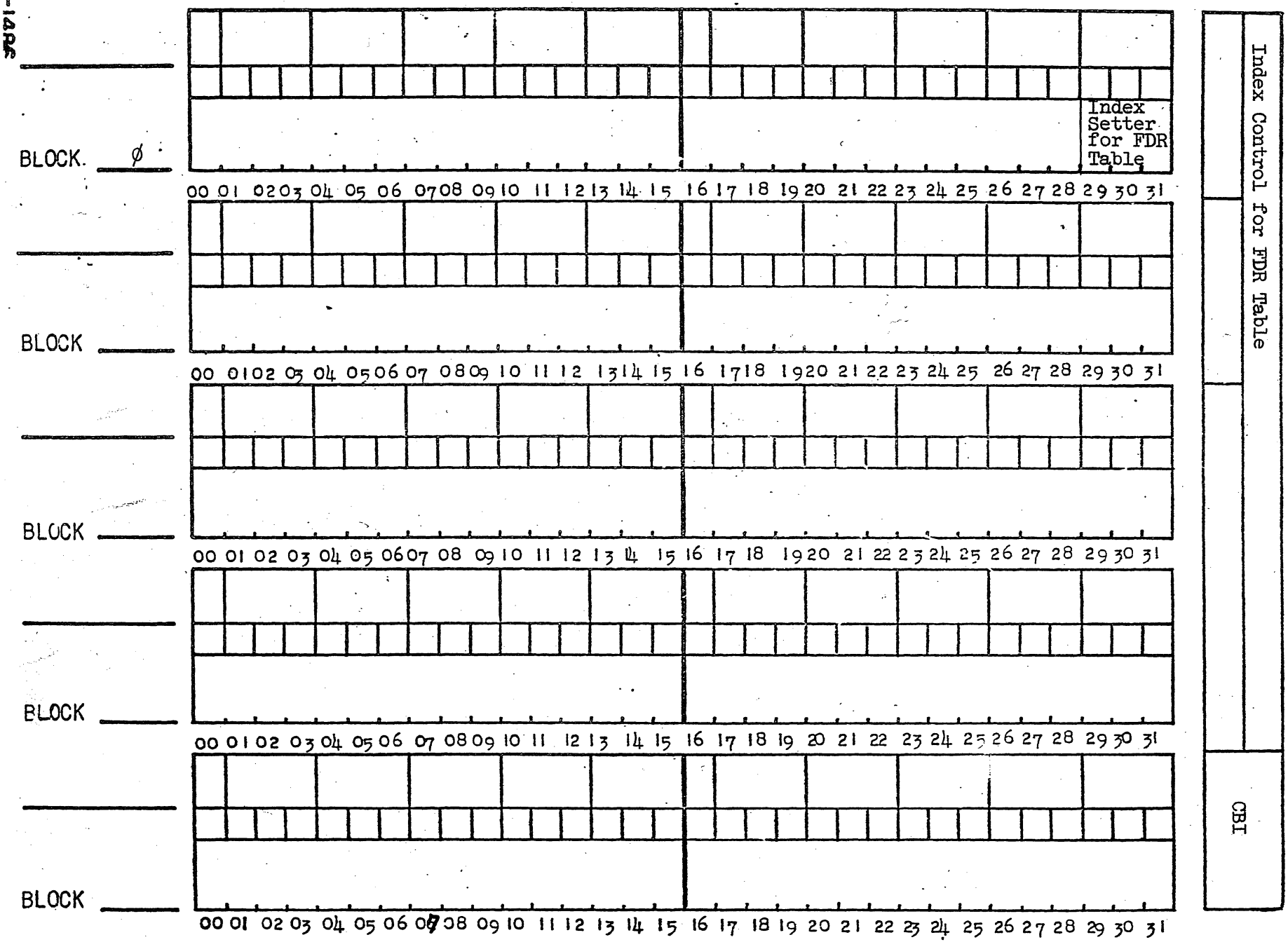

BLOCK. ø
AB1 AB2 AB3 AB4 AB5 AB6 AB7 AB8 AB9 AB10
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 1
AB11 AB12 AB13 AB14 AB15
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Airbase Initiator Assignment Table
ABI

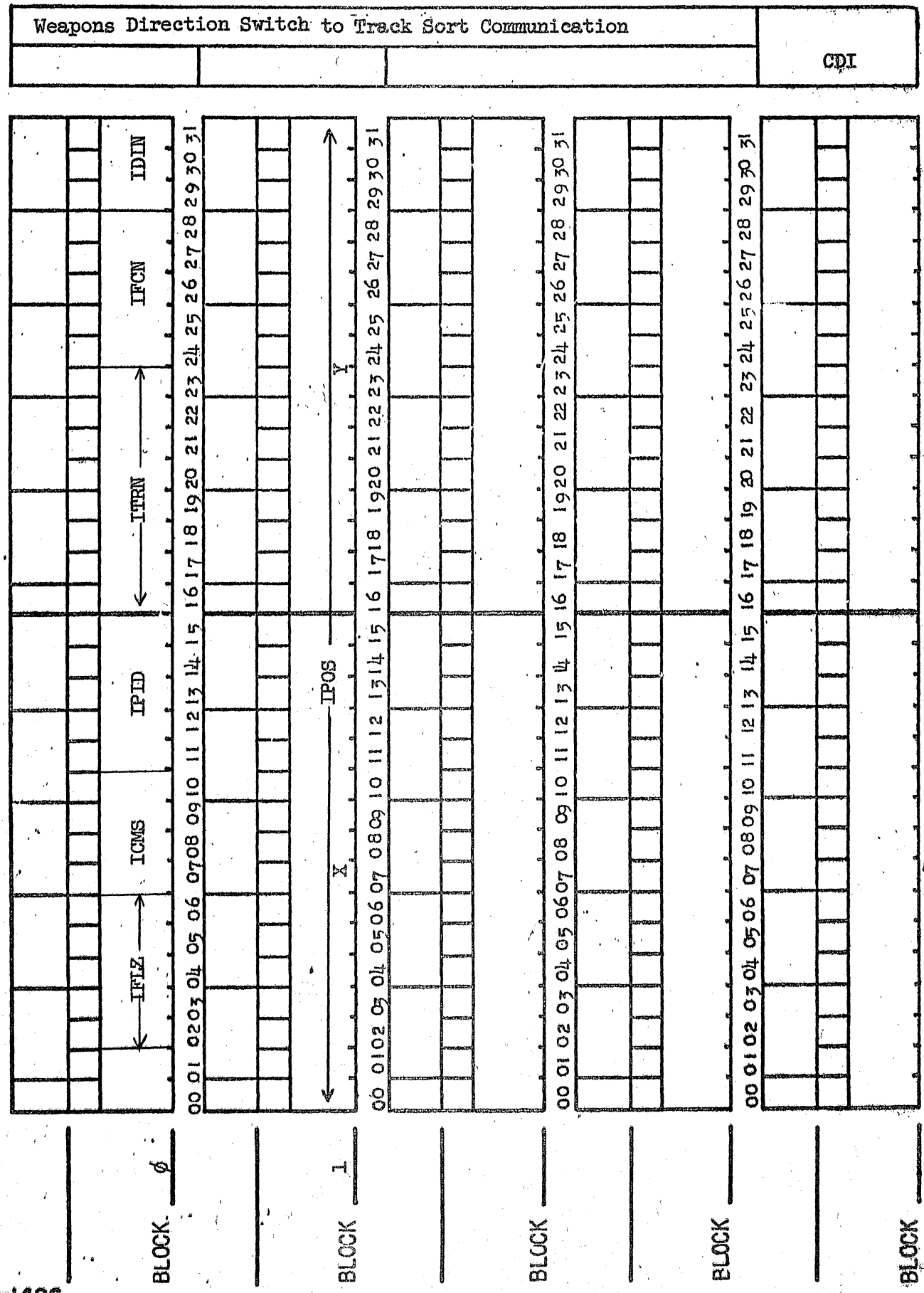

WORD Ø
BLOCK
Radar Type
Sim ID
Site ID
Number of 2 word Radar Returns
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
WORD 1
BLOCK
+ -
Sin Θ
Slant Range
+ -
Cos Θ
+ -
Extrapolation Time
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
WORD 2
BLOCK
X (1/32 mi)
Y (1/32 mi)
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
Word Ø is repeated once for each site
Words 1/2 are repeated for every return for each site
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Final
BLOCK
All
Zero's
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Correlation Radar Returns
ATA


Track Bookkeeping Table
ATB
BLOCK 0
DSXA
MXCI
CARF
DSYA
CARA
CARB
CARC
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 1
DSXB
NRSA
DSYB
PFCI
PLFC
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 2
DSXC
GDAI
GDBI
GDCI
GDPI
DSYC
INSC
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 3
DXSM
MISI
ATEI
DSTI
MXER
DYSM
MXSC
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

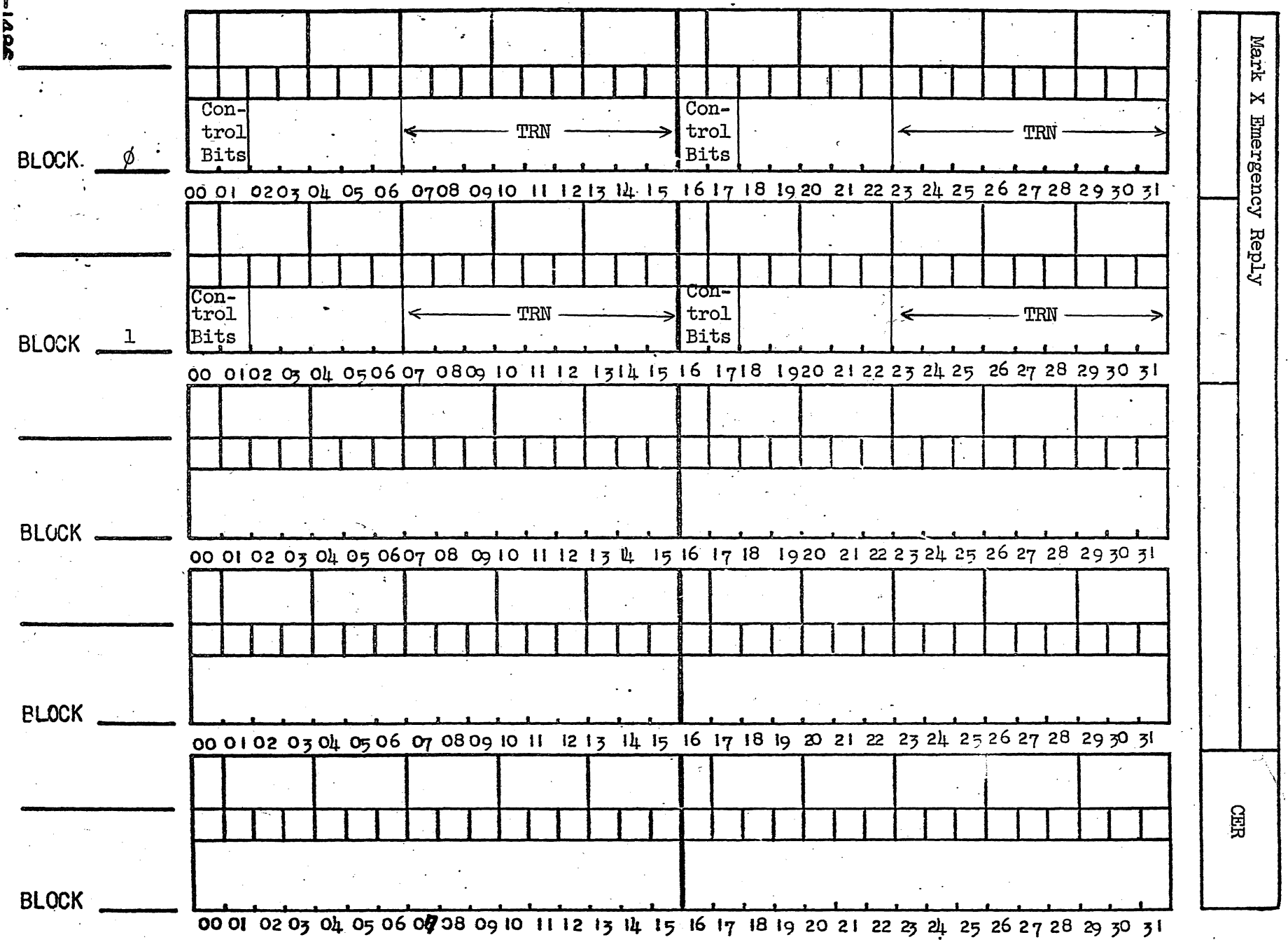

Word Ø
BLOCK
Type Radar
Sim. Ind.
Site No.
Spare
Spare
No. of Returns
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Word 1
BLOCK
X (1/4 Mile)
Y (1/4 Mile)
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Simulated Radar Returns
ATS
Auto. Tracking Simulated Peripheral Table


BLOCK.
BLOCK
BLOCK
BLOCK
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
*Message Indicator
*IPOI Alarm Indicator
Central Bookkeeping Alarms
CBA


BLOCK. ø
Index Setter for FDR Table
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Index Control for FDR Table
CBI


Weapons Direction Switch to Track Sort Communication
CDI
IDIN
IFCN
ITRN
IPTD
ICMS
IFLZ
IPOS
X
Y
BLOCK Ø
BLOCK 1
BLOCK
BLOCK
BLOCK
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

DL-1486


BLOCK. ø
BLOCK 1
BLOCK
BLOCK
BLOCK
Con-trol Bits
TRN
Con-trol Bits
TRN
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Mark X Emergency Reply
CER

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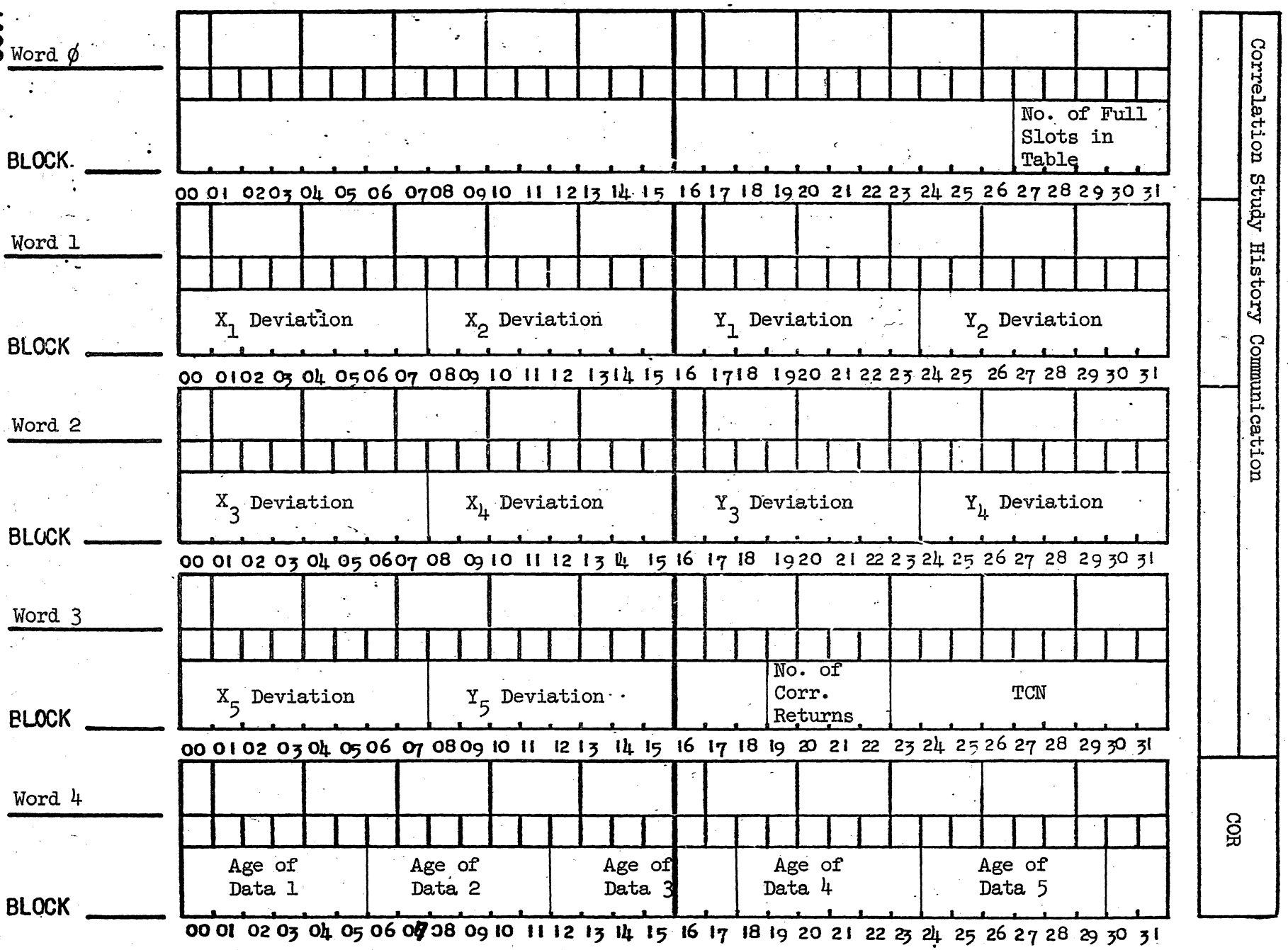
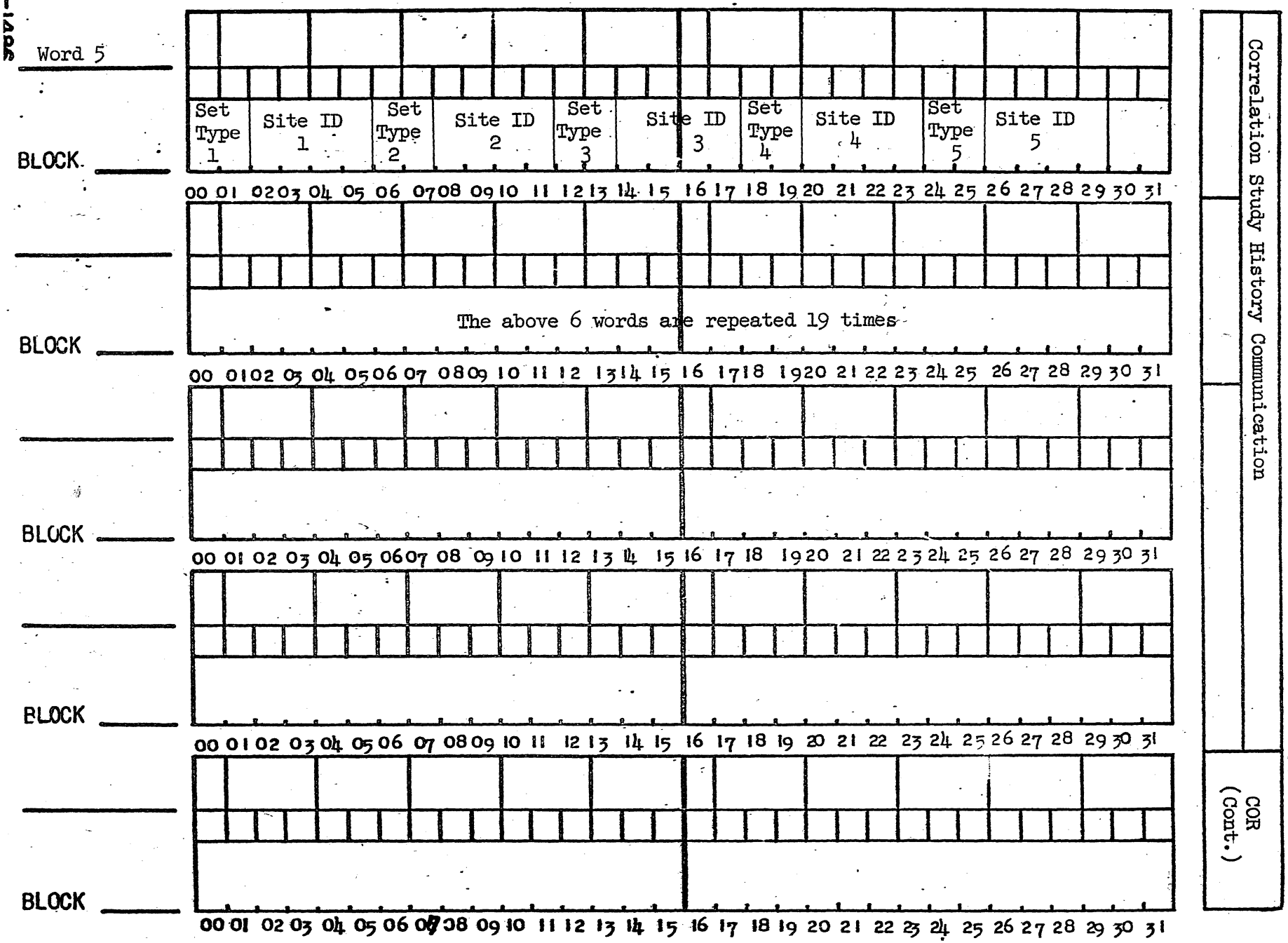
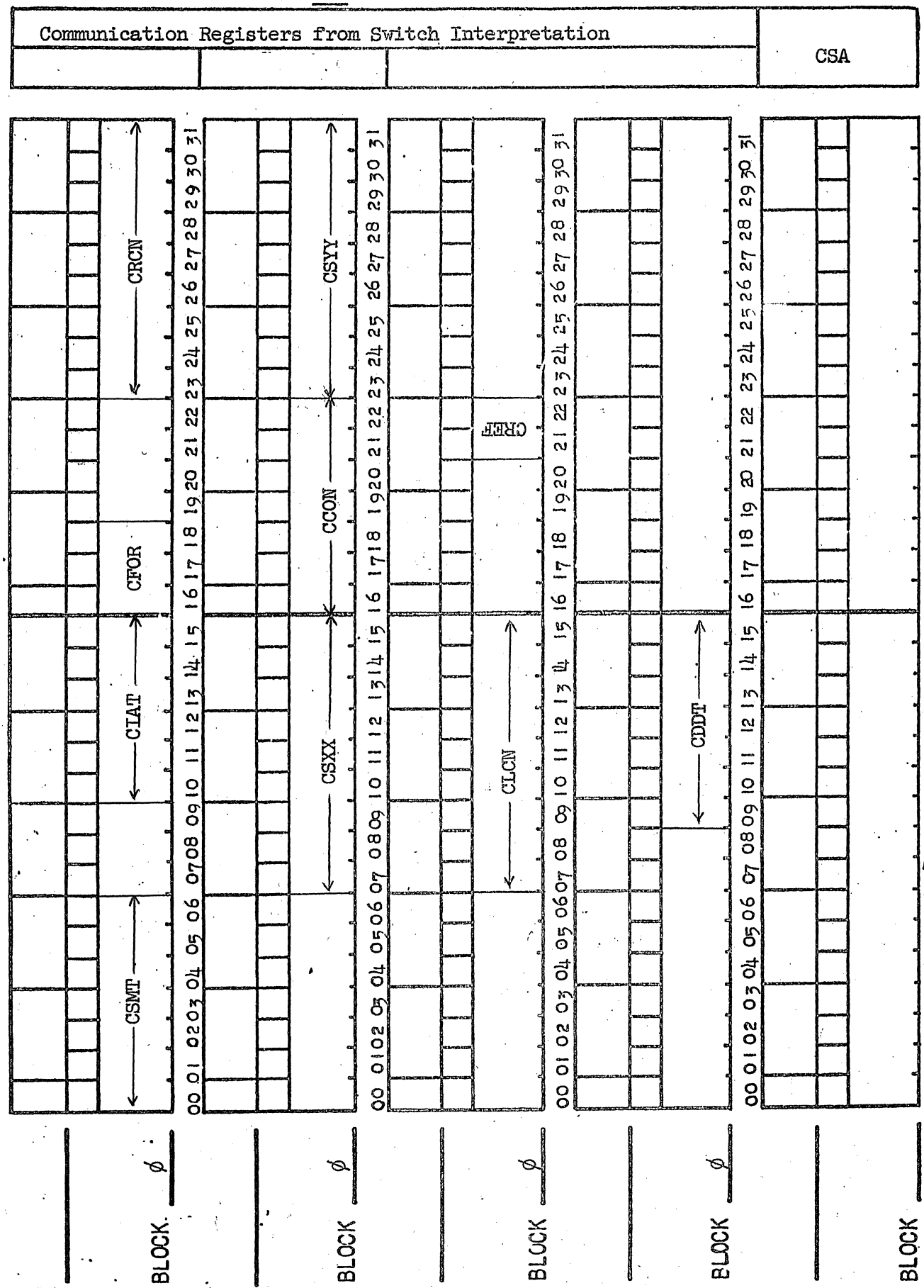


6M-4851


Word 5
BLOCK
Set Type 1
Site ID 1
Set Type 2
Site ID 2
Set Type 3
Site ID 3
Set Type 4
Site ID 4
Set Type 5
Site ID 5
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
The above 6 words are repeated 19 times
BLOCK
BLOCK
BLOCK
Correlation Study History Communication
COR (Cont.)

Note: Word Format not Standard!



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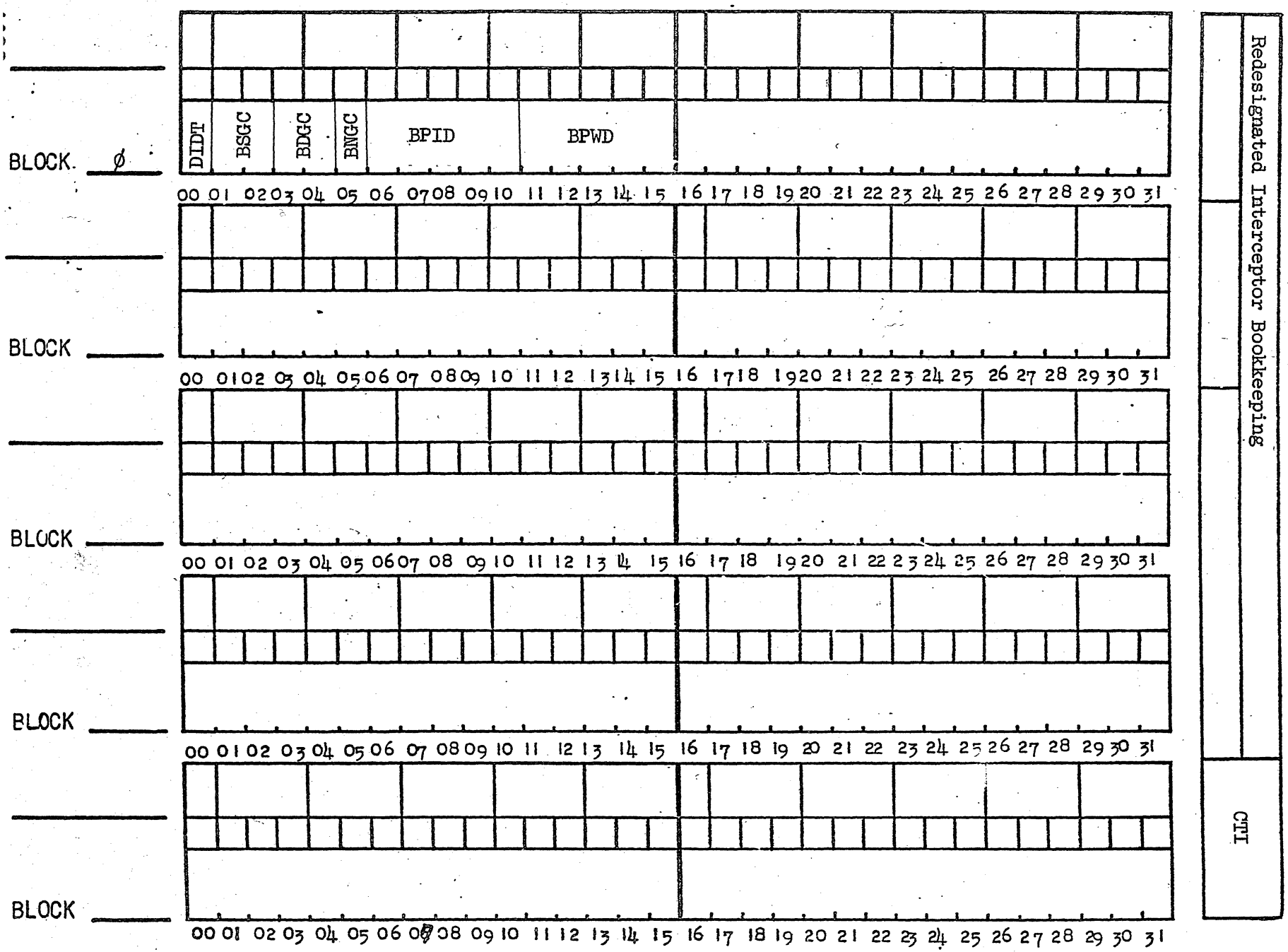
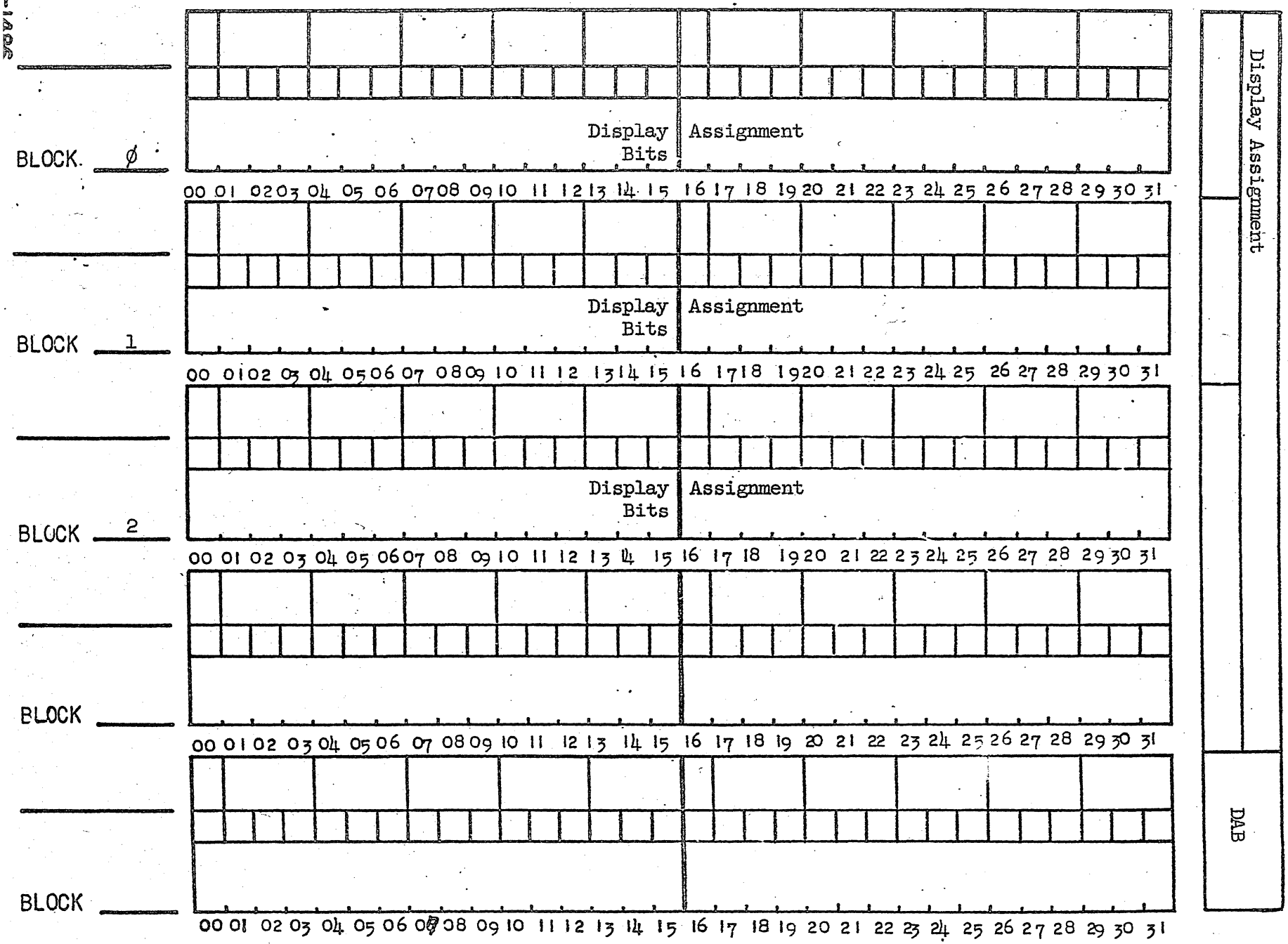
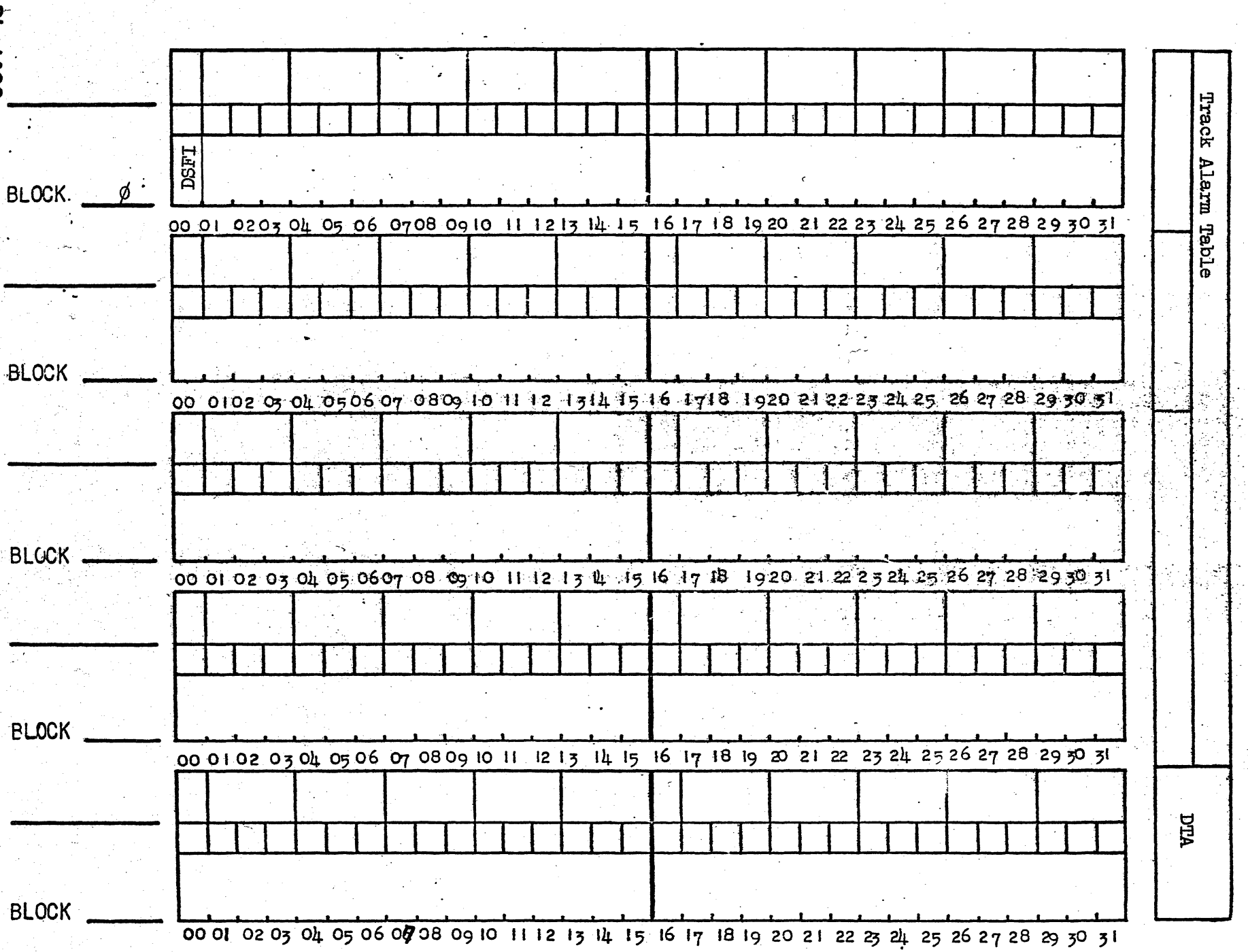
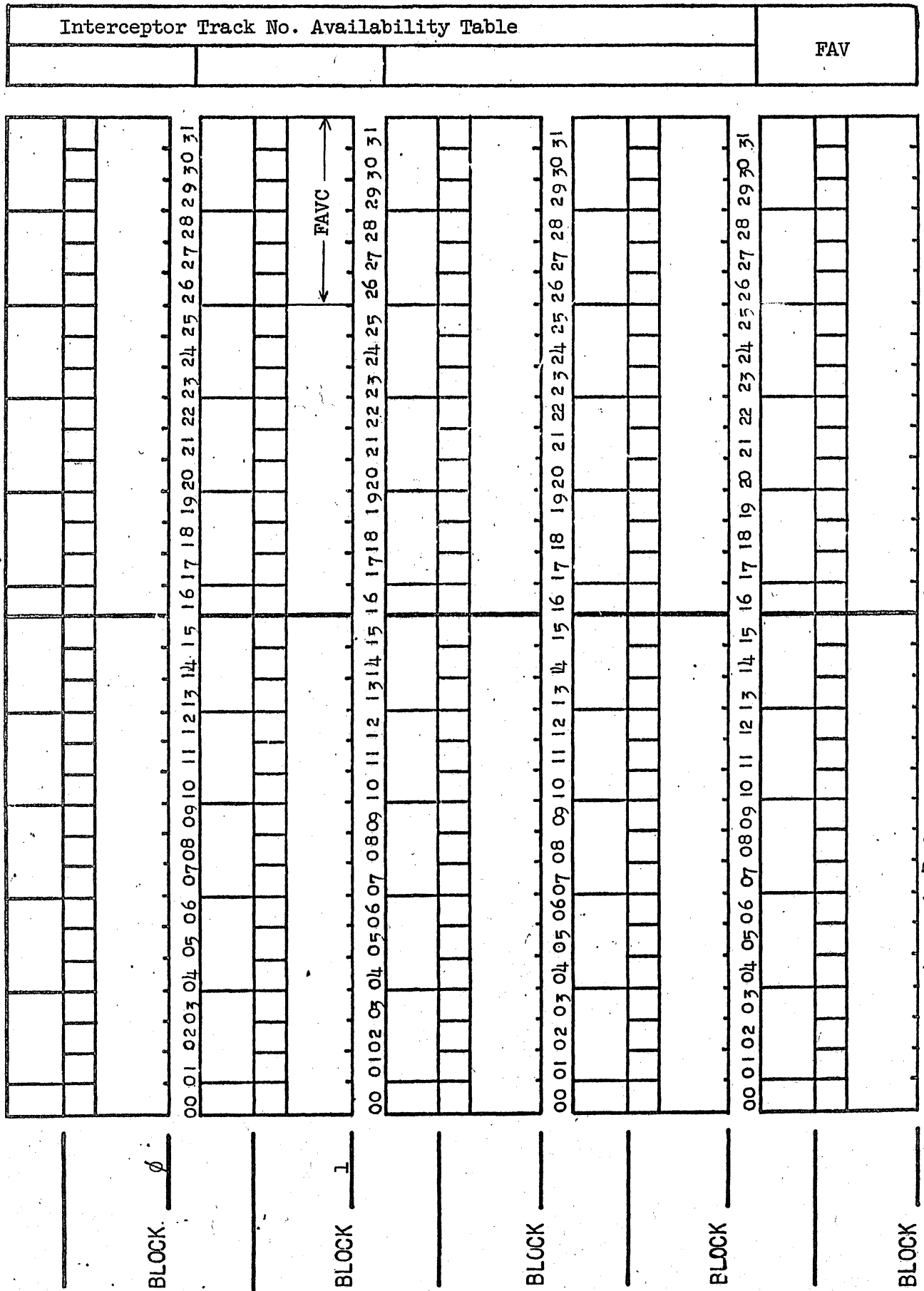

BLOCK ø
DIDT
BSGC
BDGC
BNGC
BPID
BPWD
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
BLOCK
BLOCK
BLOCK
Redesignated Interceptor Bookkeeping
CTI


BLOCK. Ø
Display Bits
Assignment
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 1
Display Bits
Assignment
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 2
Display Bits
Assignment
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Display Assignment
DAB


DL-1486
BLOCK. ø
DSFI
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Track Alarm Table
DTA


Interceptor Track No. Availability Table
FAV
FAVC
BLOCK ∅
BLOCK 1
BLOCK
BLOCK
BLOCK
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

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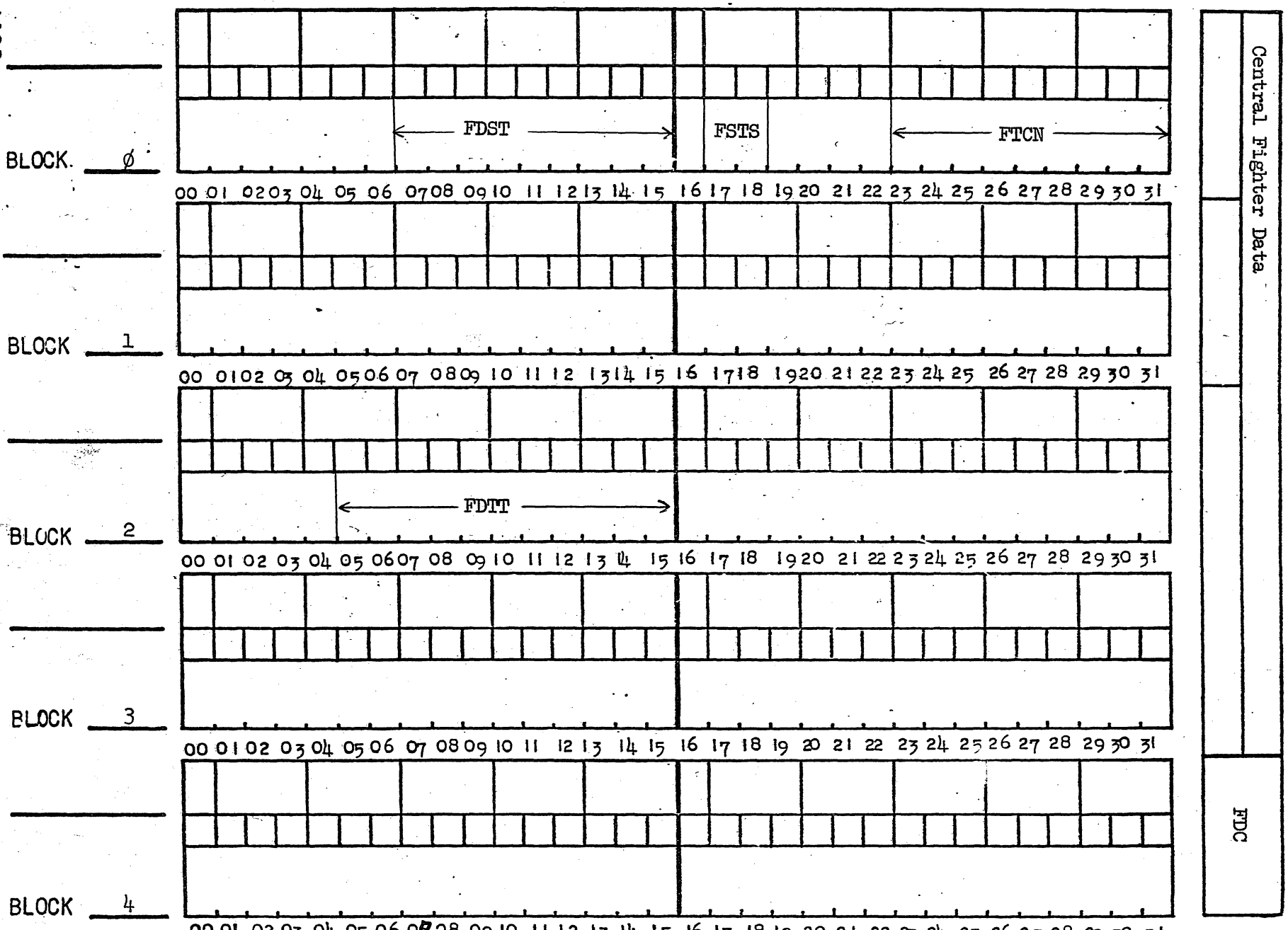
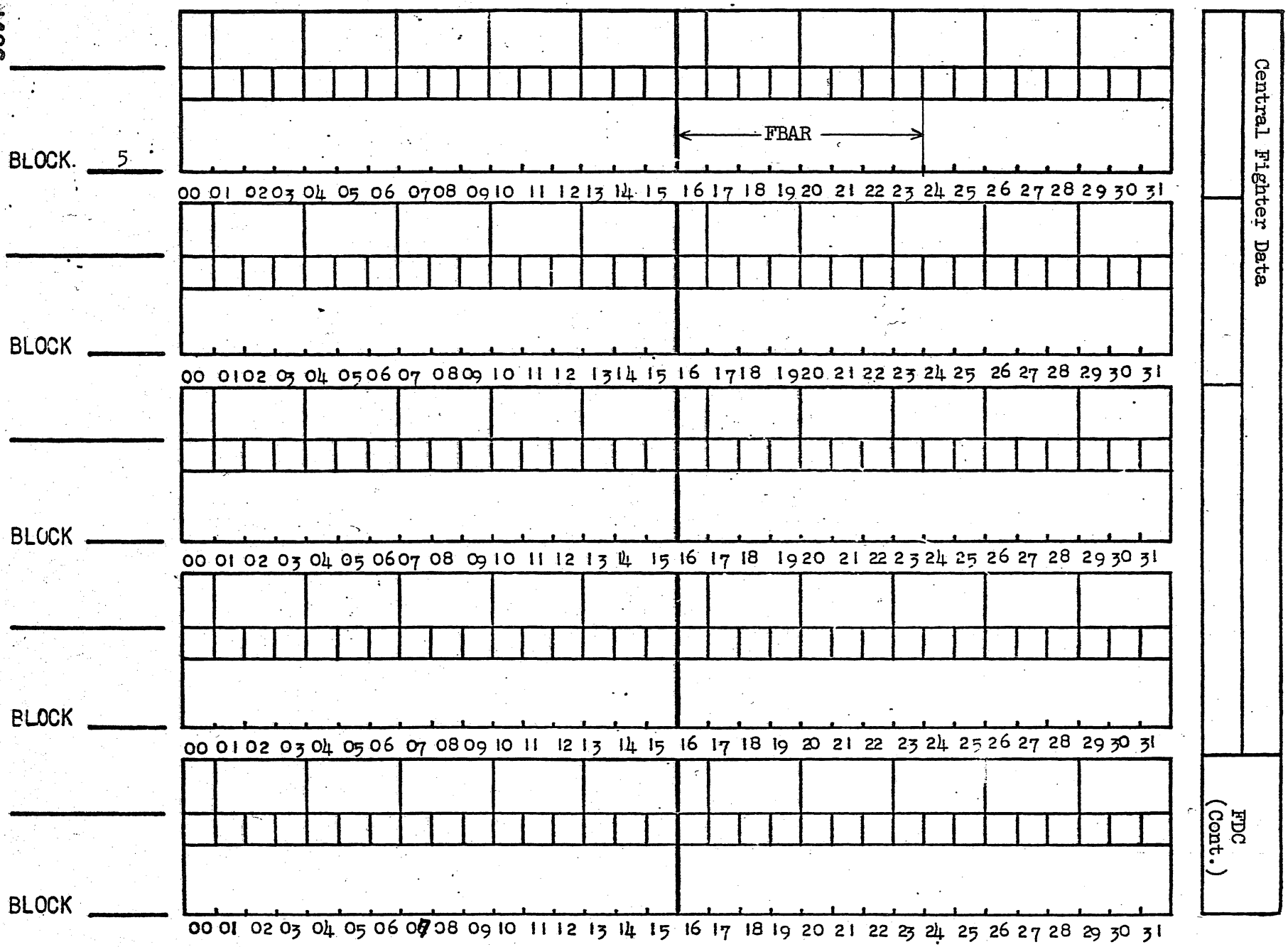
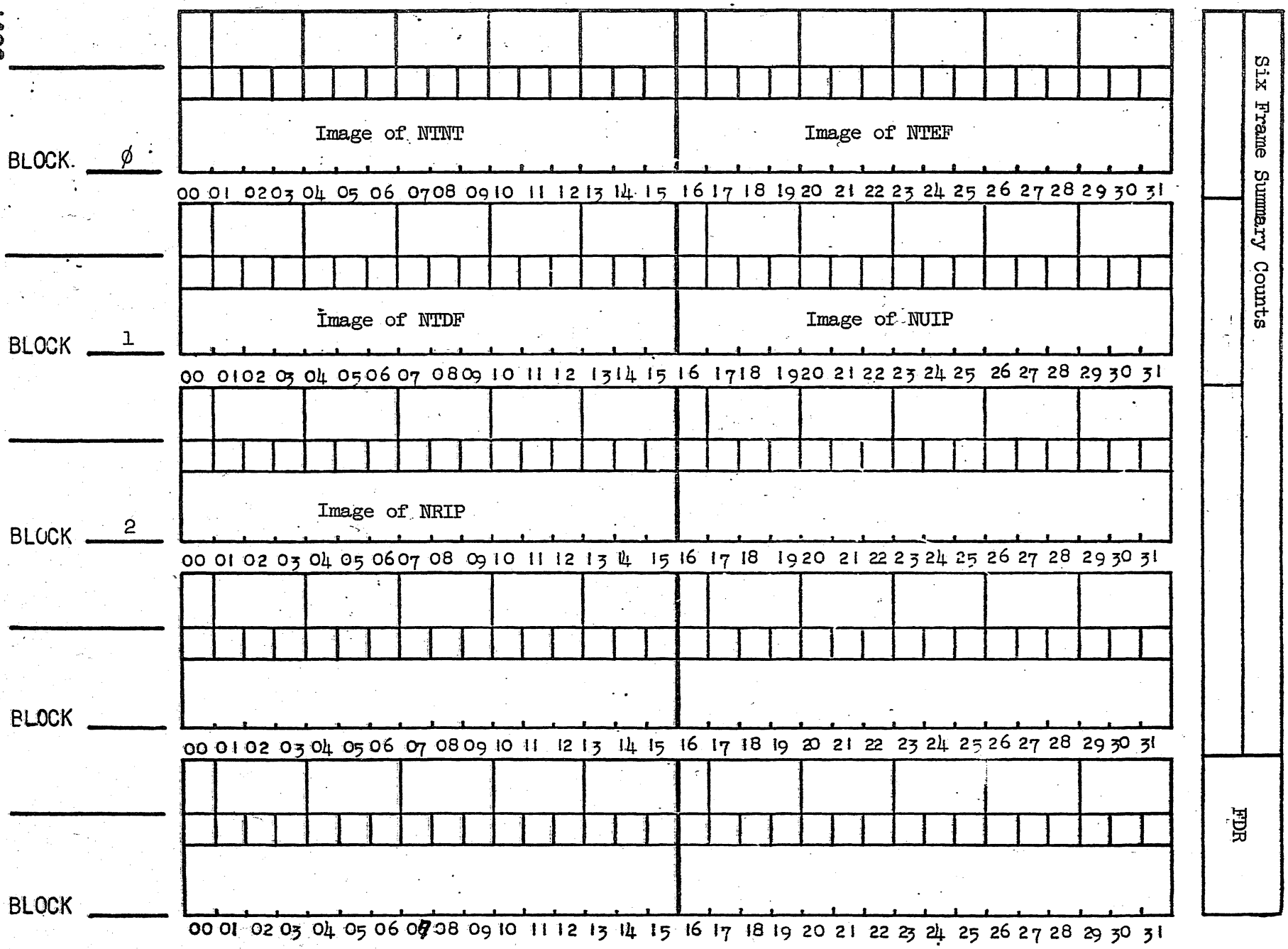

BLOCK Ø
FDST
FSTS
FTCN
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 1
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 2
FDTT
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 3
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 4
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Central Fighter Data
FDC


BLOCK. 5
FBAR
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Central Fighter Data
FDC (Cont.)


BLOCK ø
Image of NTINT
Image of NTEF
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 1
Image of NTDF
Image of NUIP
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 2
Image of NRIP
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Six Frame Summary Counts
FDR

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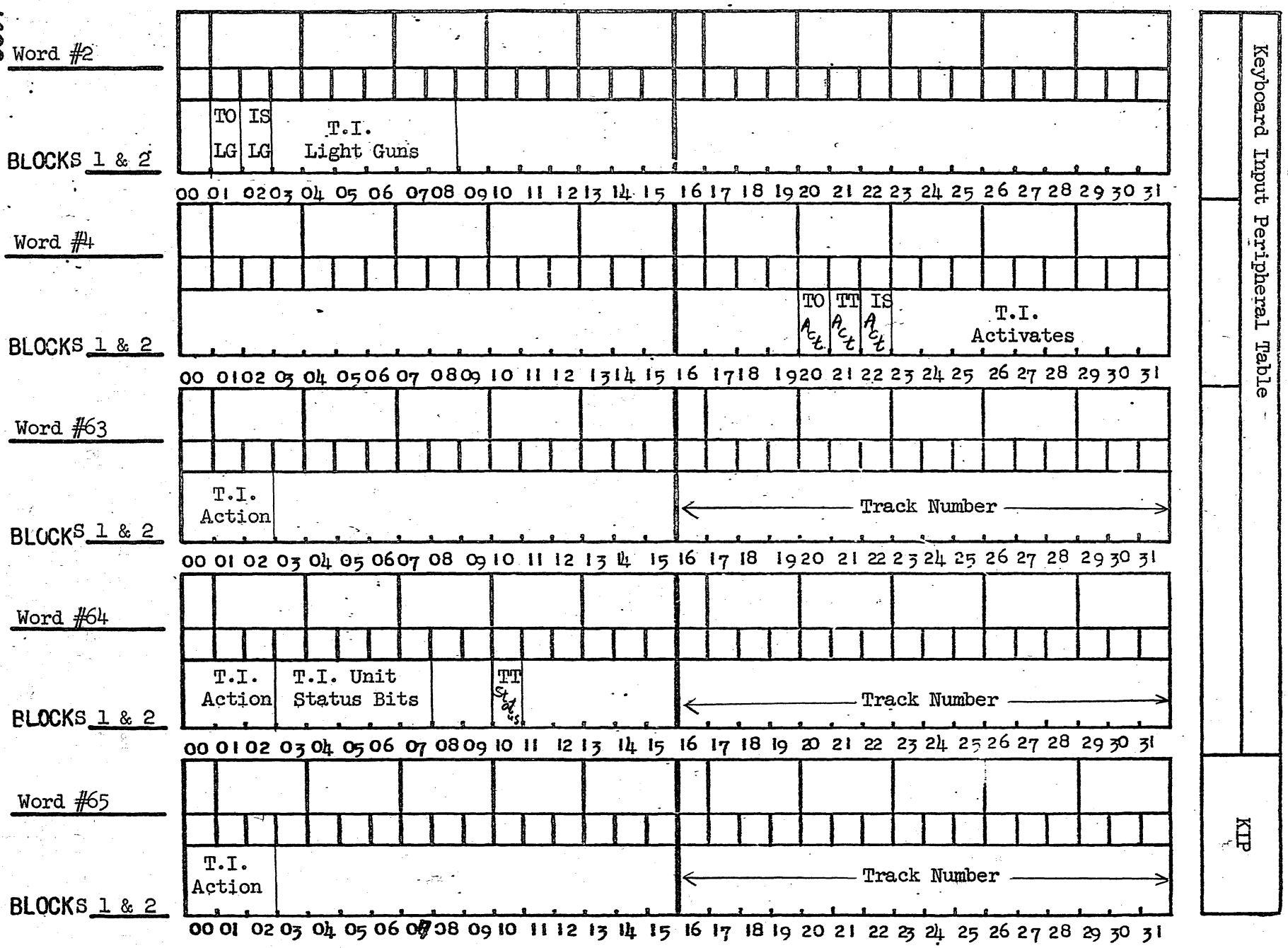
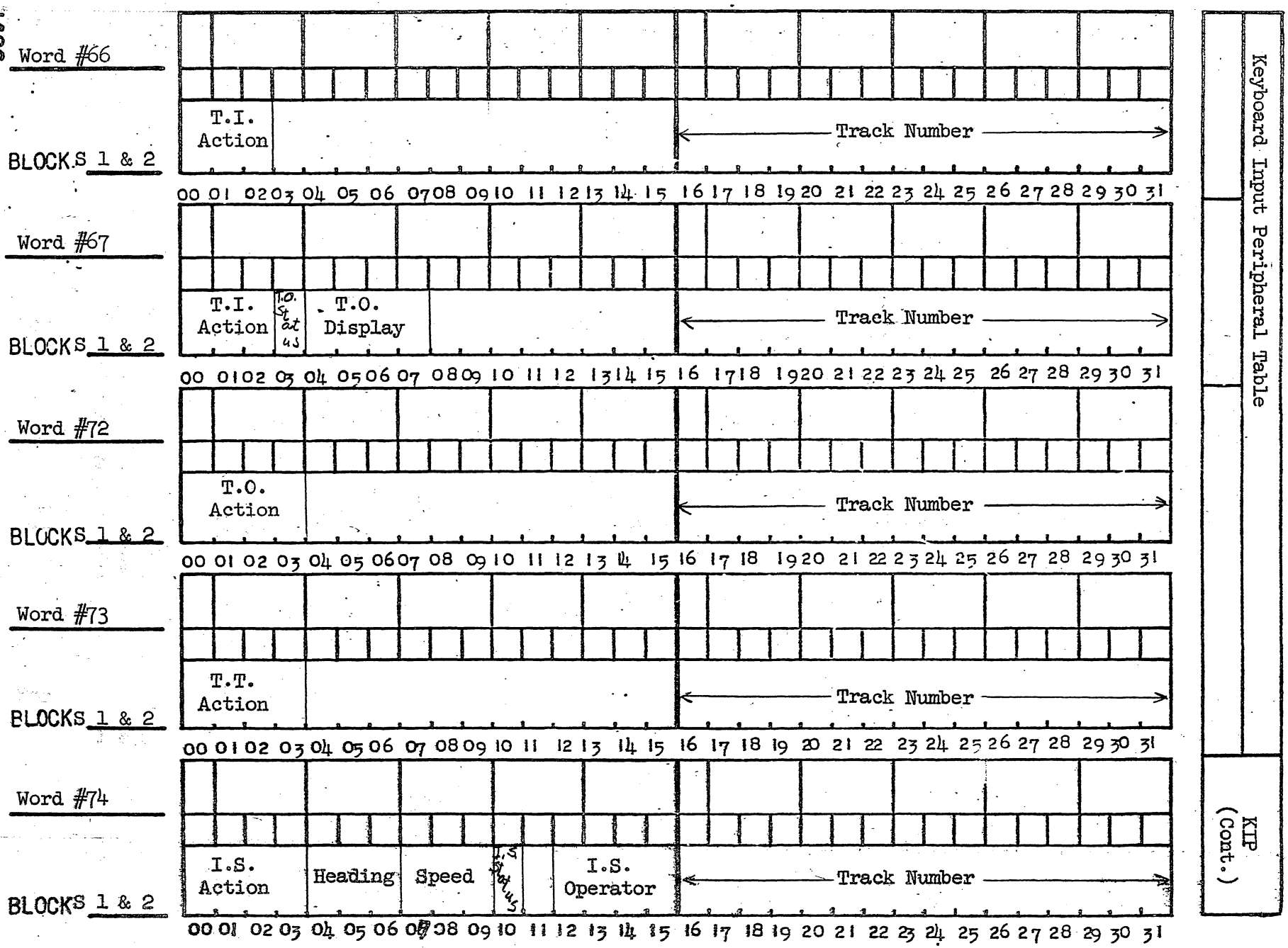
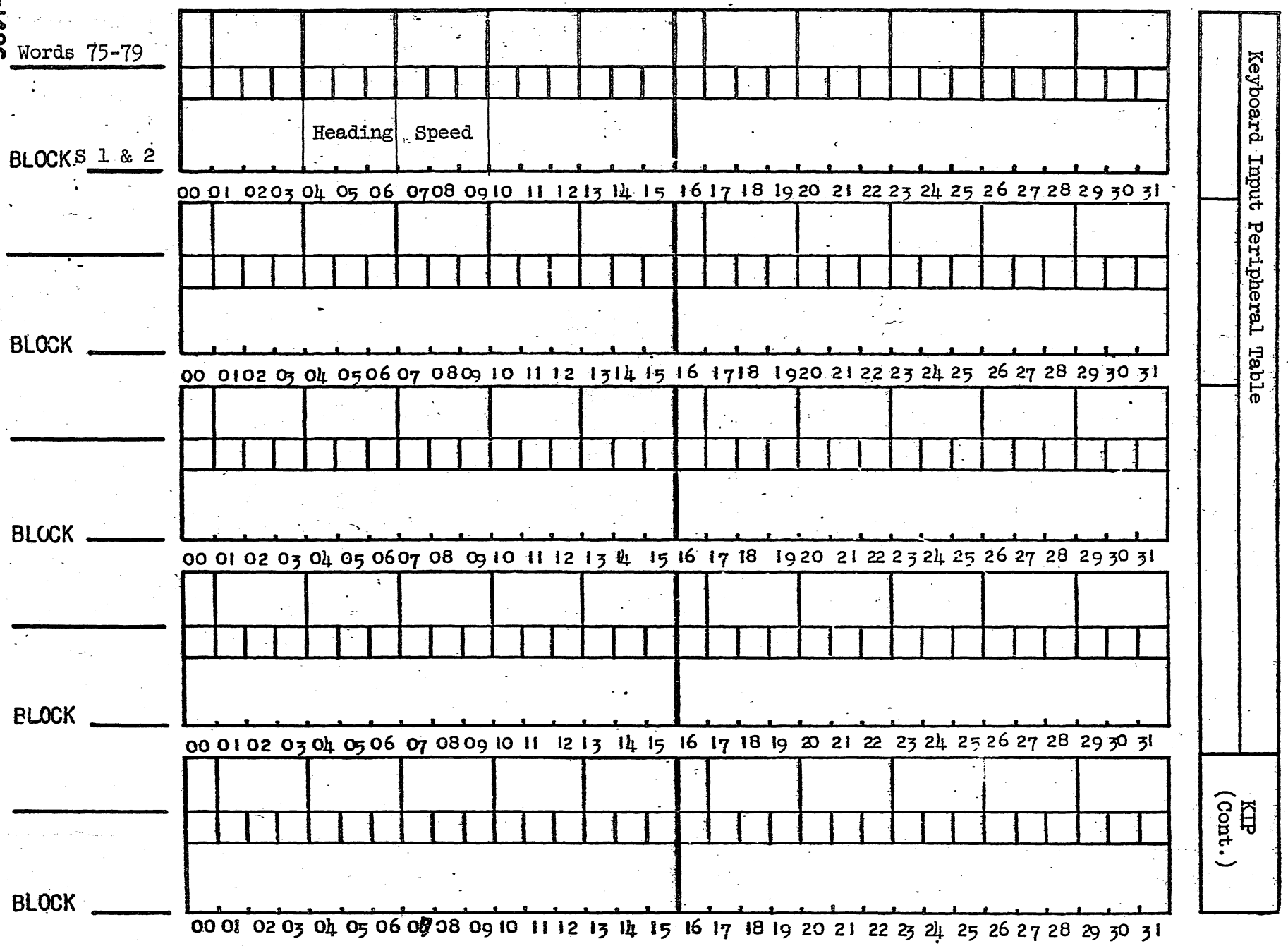

Word #2
BLOCKS 1 & 2
TO LG
IS LG
T.I. Light Guns
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Word #4
BLOCKS 1 & 2
TO Act
TT Act
IS Act
T.I. Activates
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Word #63
BLOCKS 1 & 2
T.I. Action
Track Number
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Word #64
BLOCKS 1 & 2
T.I. Action
T.I. Unit Status Bits
TT Status
Track Number
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Word #65
BLOCKS 1 & 2
T.I. Action
Track Number
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Keyboard Input Peripheral Table
KIP


Word #66
BLOCKS 1 & 2
T.I. Action
Track Number
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Word #67
BLOCKS 1 & 2
T.I. Action
T.O. Status
T.O. Display
Track Number
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Word #72
BLOCKS 1 & 2
T.O. Action
Track Number
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Word #73
BLOCKS 1 & 2
T.T. Action
Track Number
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Word #74
BLOCKS 1 & 2
I.S. Action
Heading
Speed
I.S. Status
I.S. Operator
Track Number
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Keyboard Input Peripheral Table
KIP (Cont.)


Words 75-79
BLOCKS 1 & 2
Heading
Speed
BLOCK
BLOCK
BLOCK
BLOCK
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Keyboard Input Peripheral Table
KIP (Cont.)

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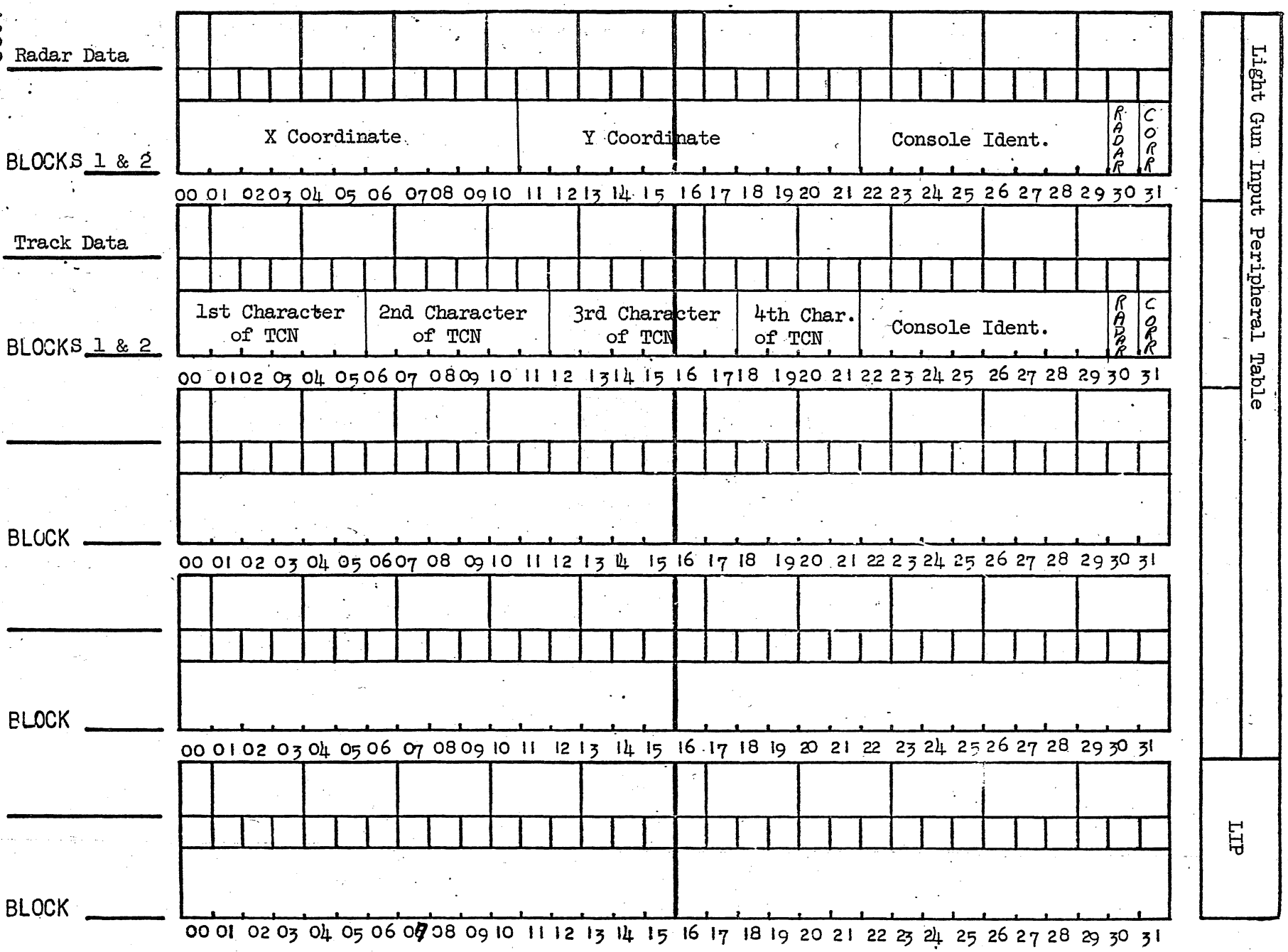
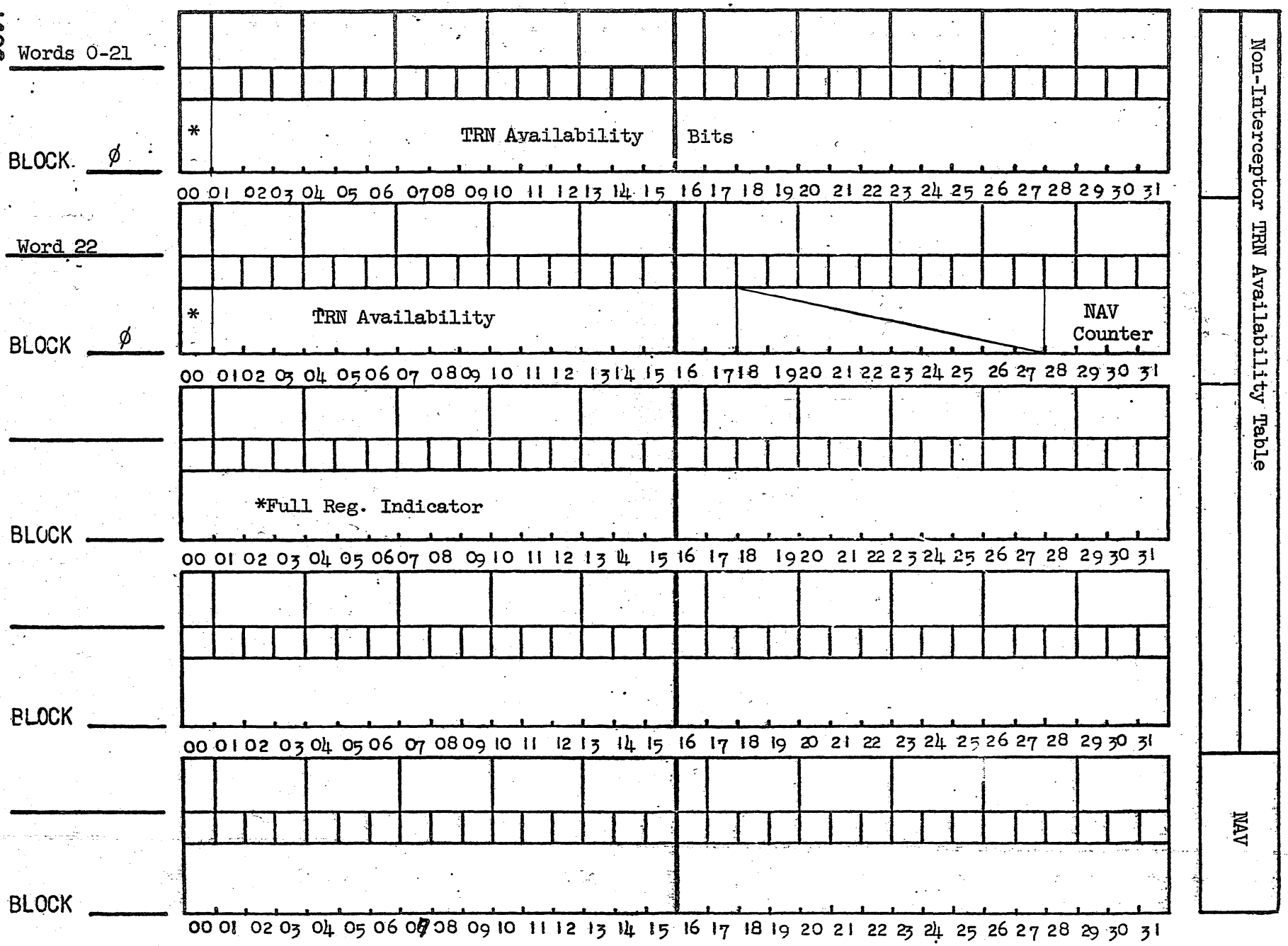
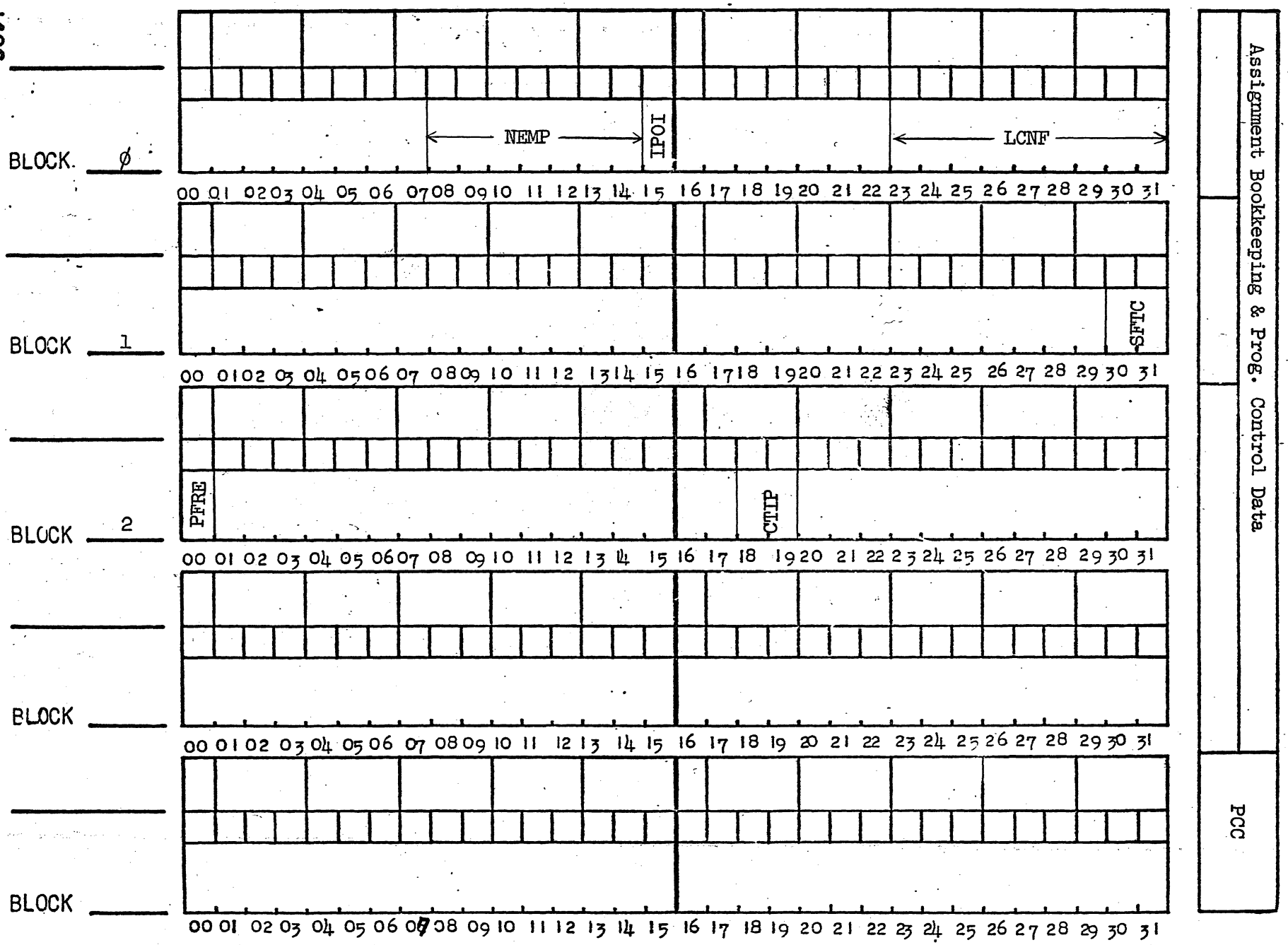
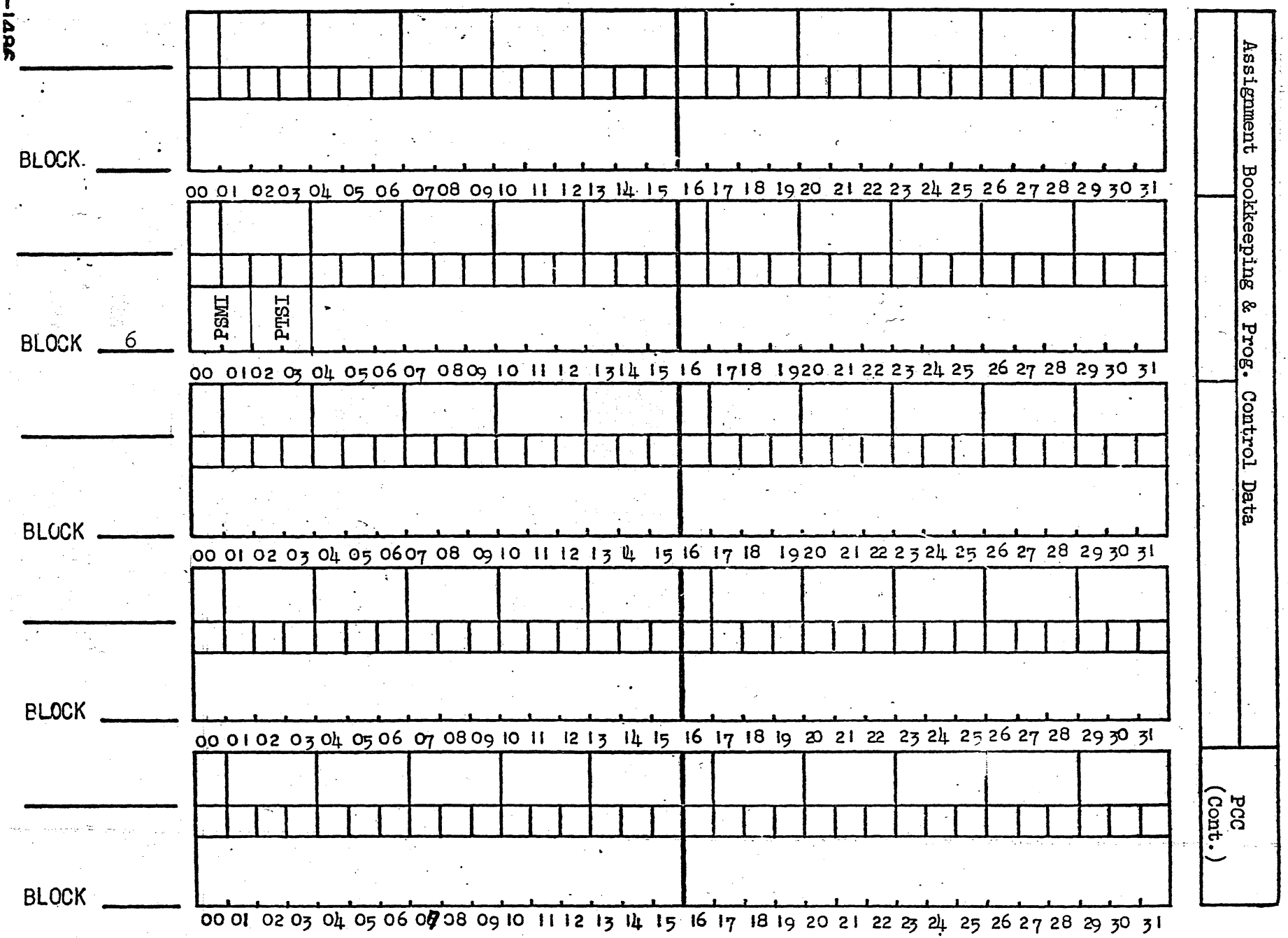
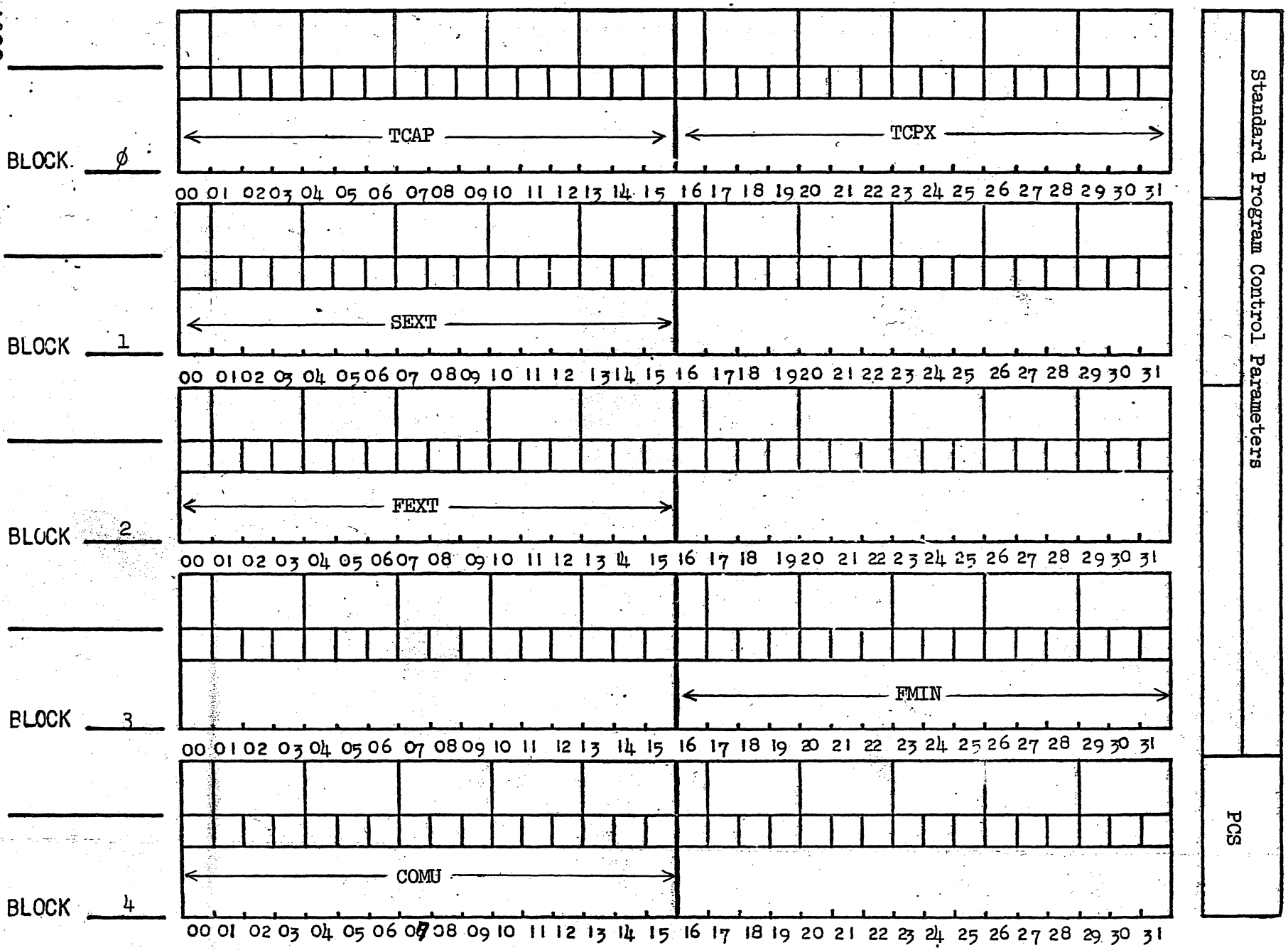
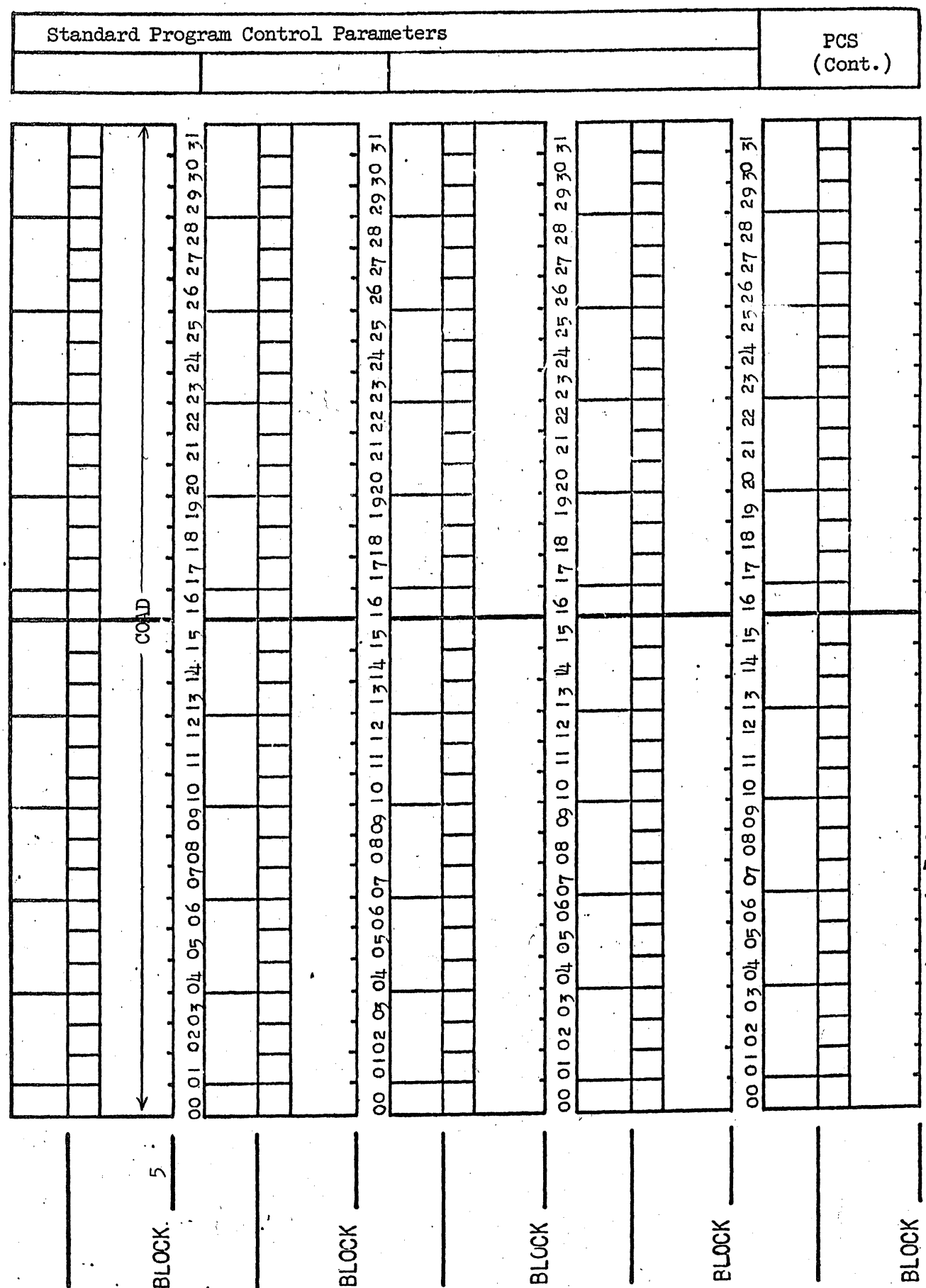

Radar Data
BLOCKS 1 & 2
X Coordinate
Y Coordinate
Console Ident.
RADAR
COOR
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Track Data
BLOCKS 1 & 2
1st Character of TCN
2nd Character of TCN
3rd Character of TCN
4th Char. of TCN
Console Ident.
RADAR
COOR
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Light Gun Input Peripheral Table
LIP


Words 0-21
BLOCK Ø
*
TRN Availability Bits
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Word 22
BLOCK Ø
*
TRN Availability
NAV Counter
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
*Full Reg. Indicator
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Non-Interceptor TRN Availability Table
NAV


BLOCK ø
NEMP
IOII
LCNF
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 1
SFTC
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 2
PFRE
CTLP
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Assignment Bookkeeping & Prog. Control Data
PCC


BLOCK
BLOCK 6
PSMI
PTSI
BLOCK
BLOCK
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Assignment Bookkeeping & Prog. Control Data
PCC (Cont.)


BLOCK Ø
TCAP
TCPX
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 1
SEXT
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 2
FEXT
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 3
FMIN
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 4
COMU
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Standard Program Control Parameters
PCS


Standard Program Control Parameters
PCS (Cont.)
COLD
BLOCK
BLOCK
BLOCK
BLOCK
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

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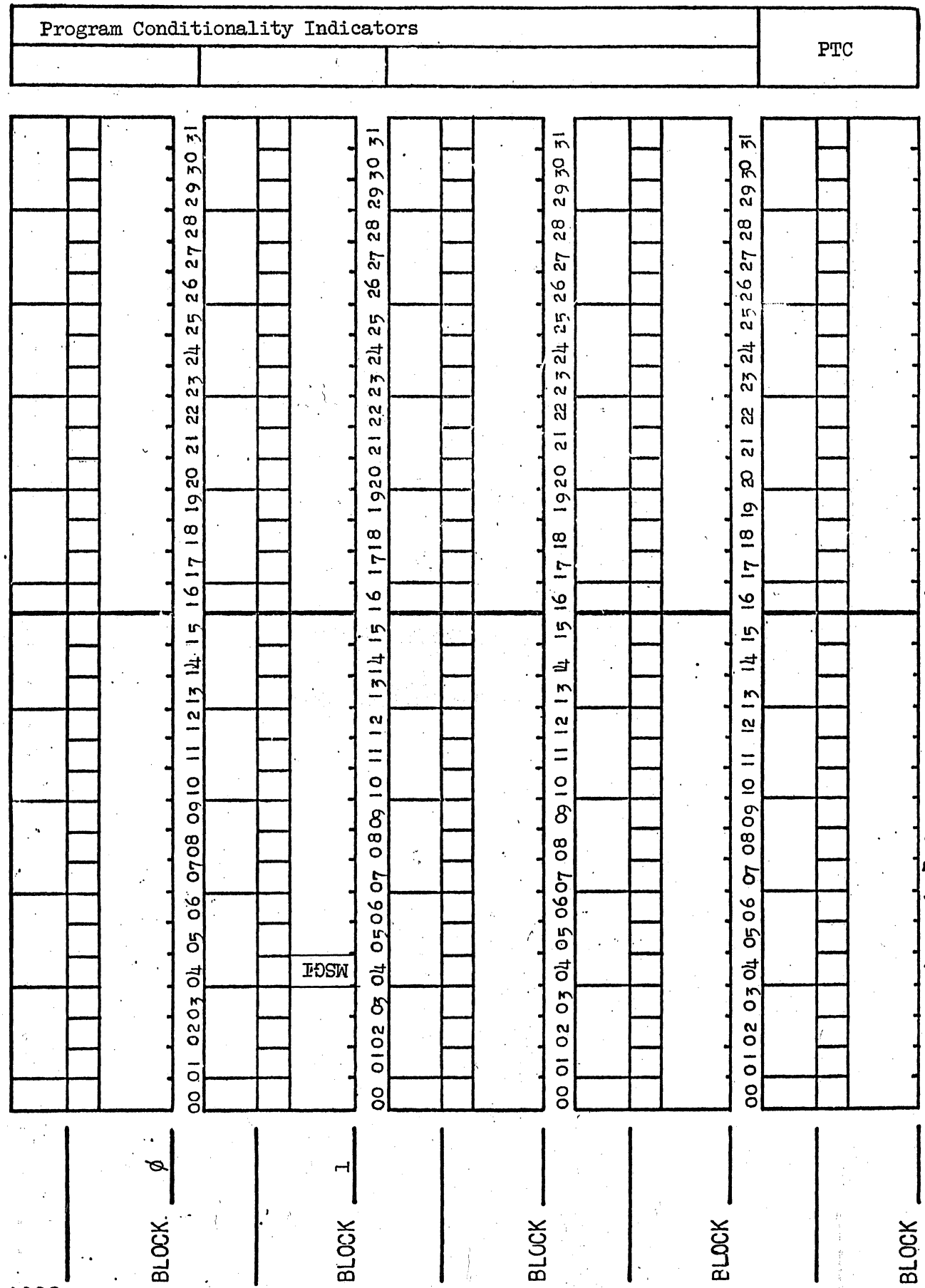
Program Conditionality Indicators
PTC
BLOCK ø
BLOCK 1
BLOCK
BLOCK
BLOCK
BLOCK
MSG1
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

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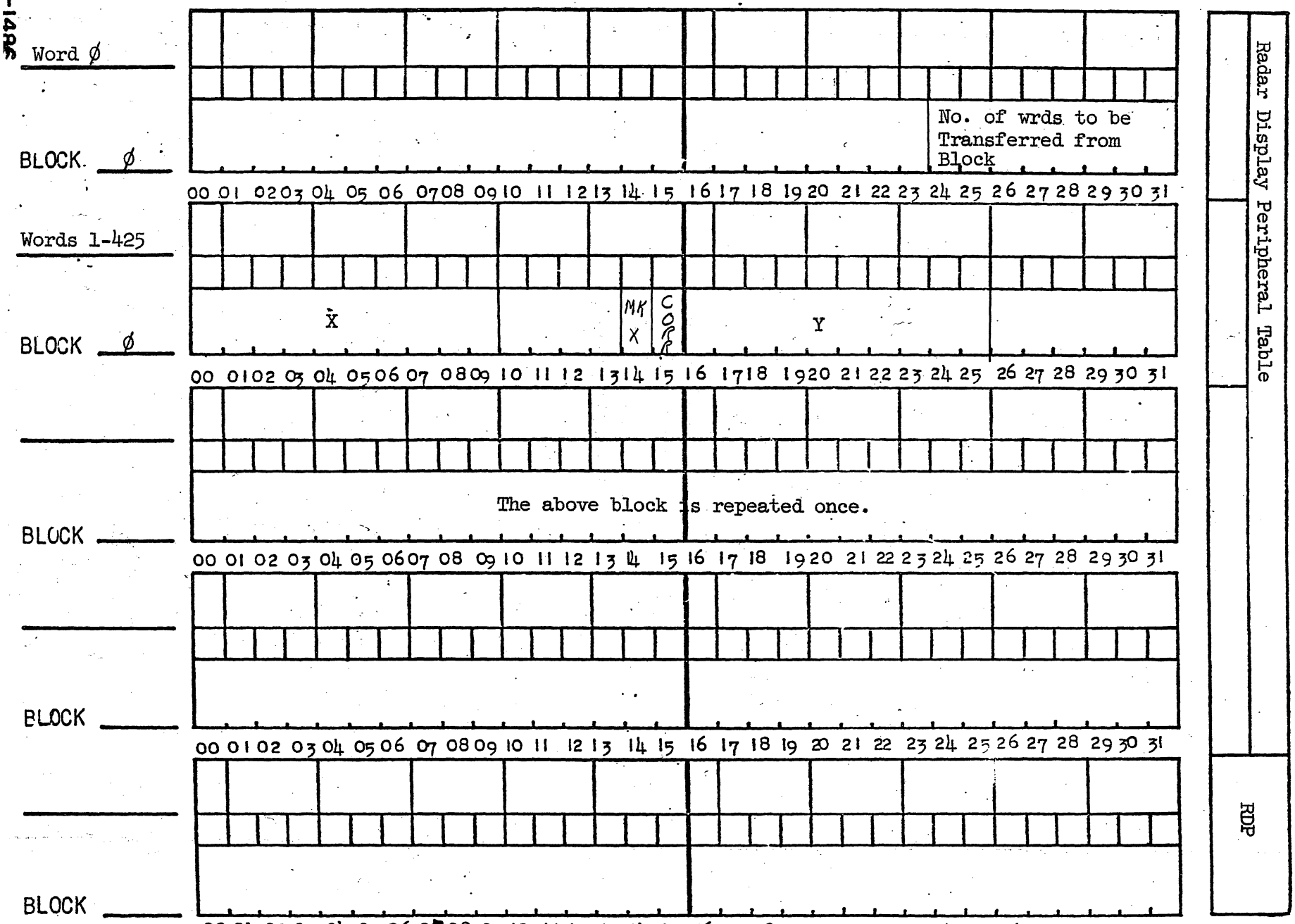
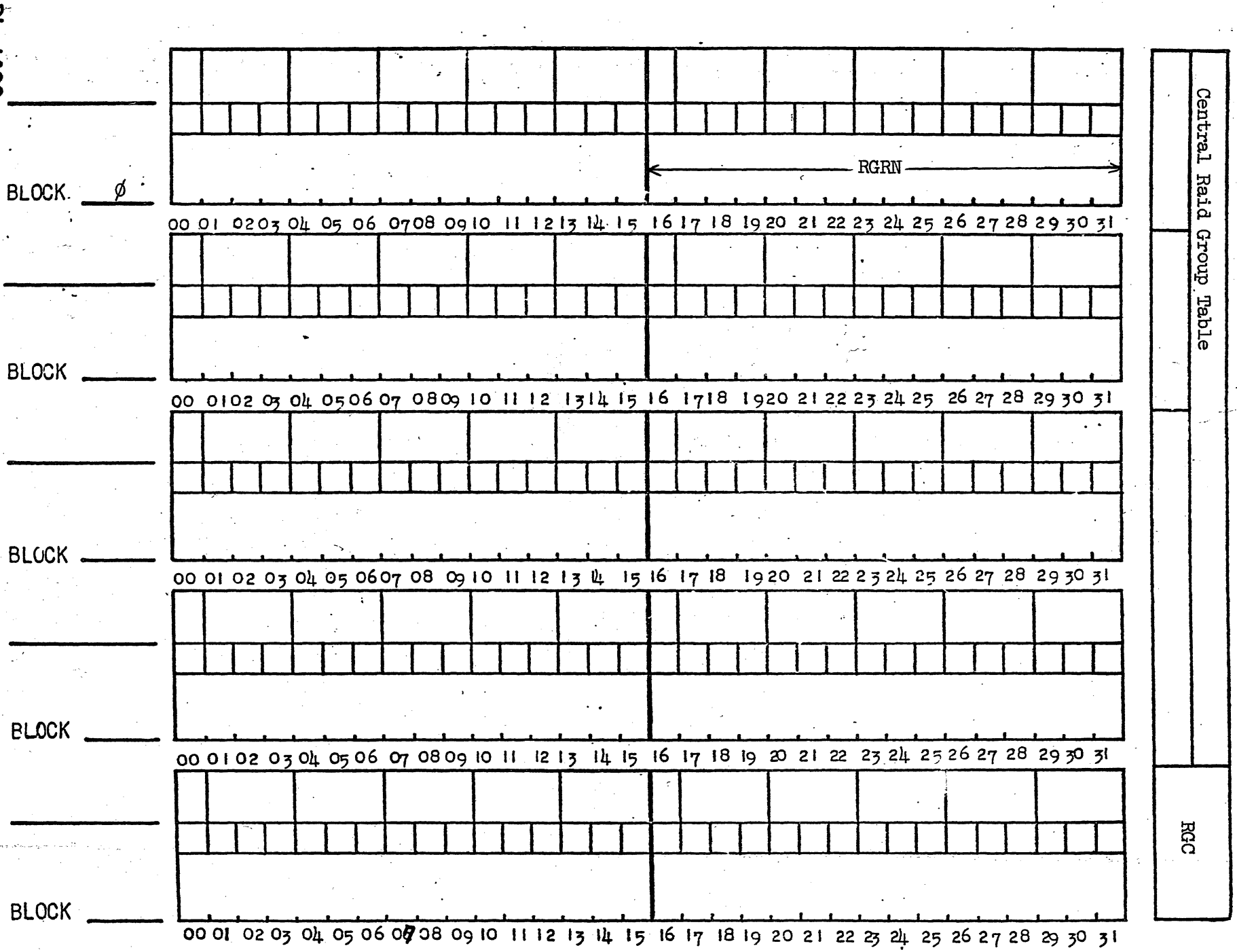

Word Ø
BLOCK Ø
No. of wrds to be Transferred from Block
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Words 1-425
BLOCK Ø
X
MK X
COS
Y
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
The above block is repeated once.
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Radar Display Peripheral Table
RDP


DL-1486
BLOCK Ø
RGRN
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Central Raid Group Table
RGC

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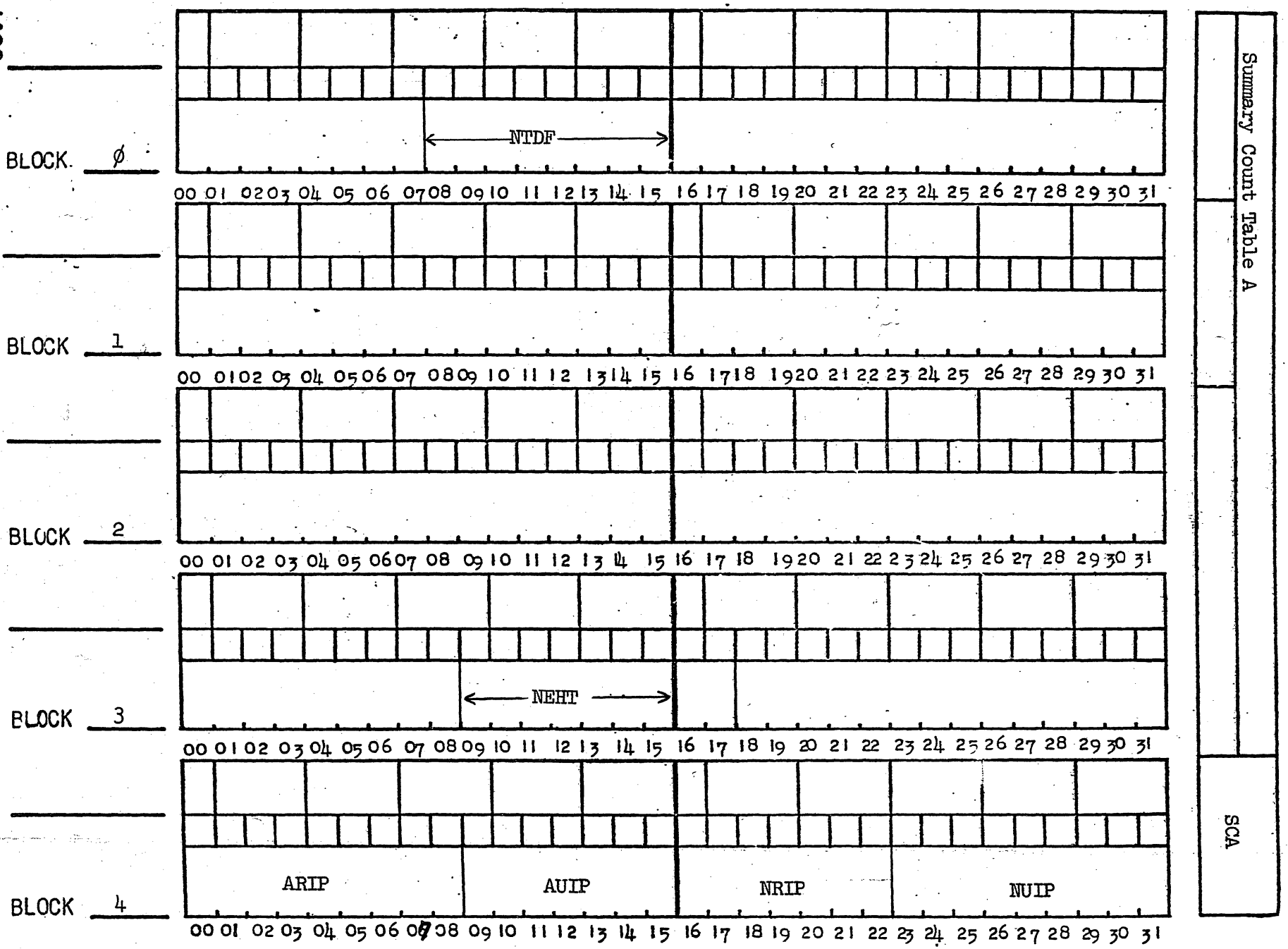

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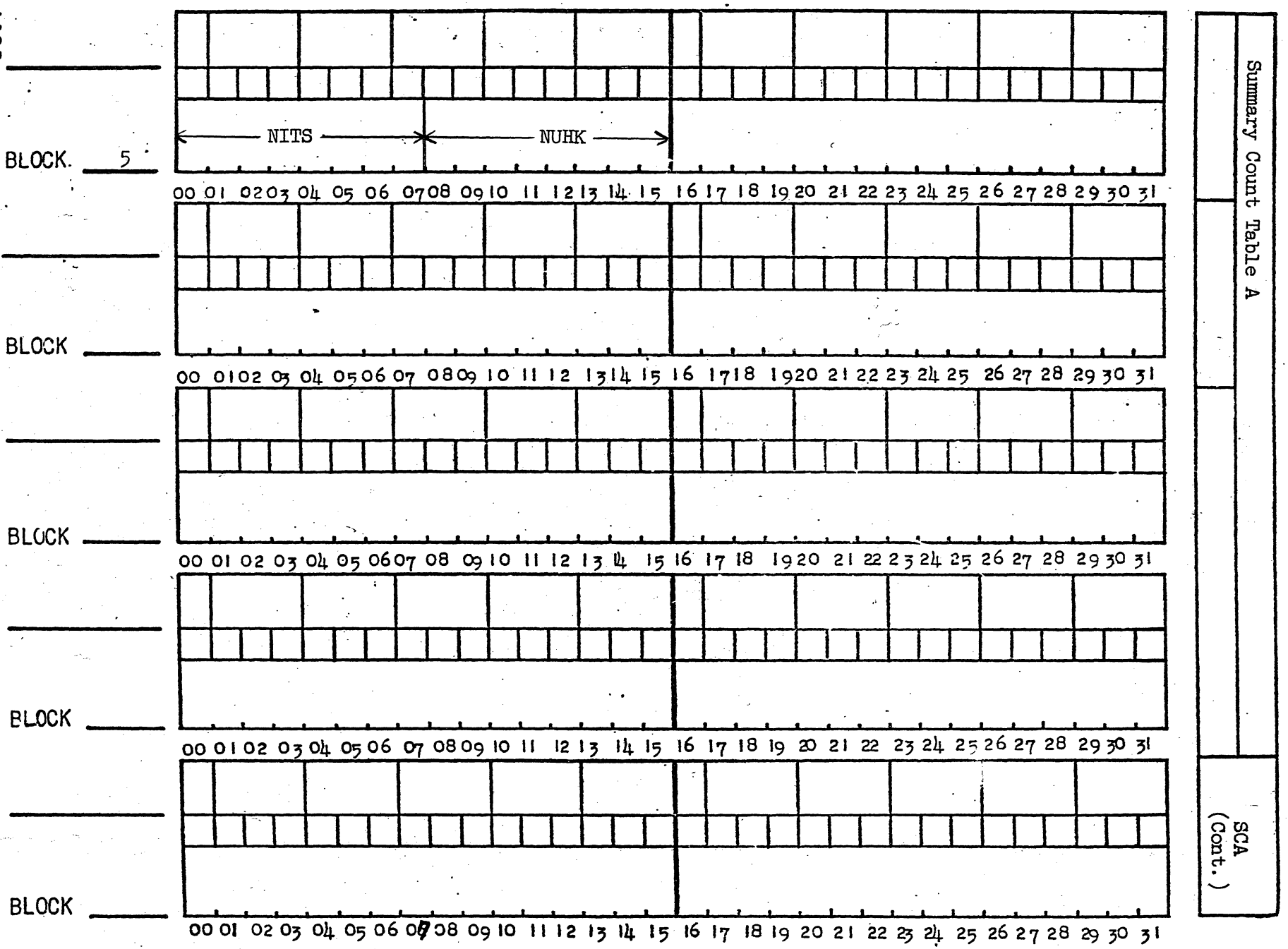
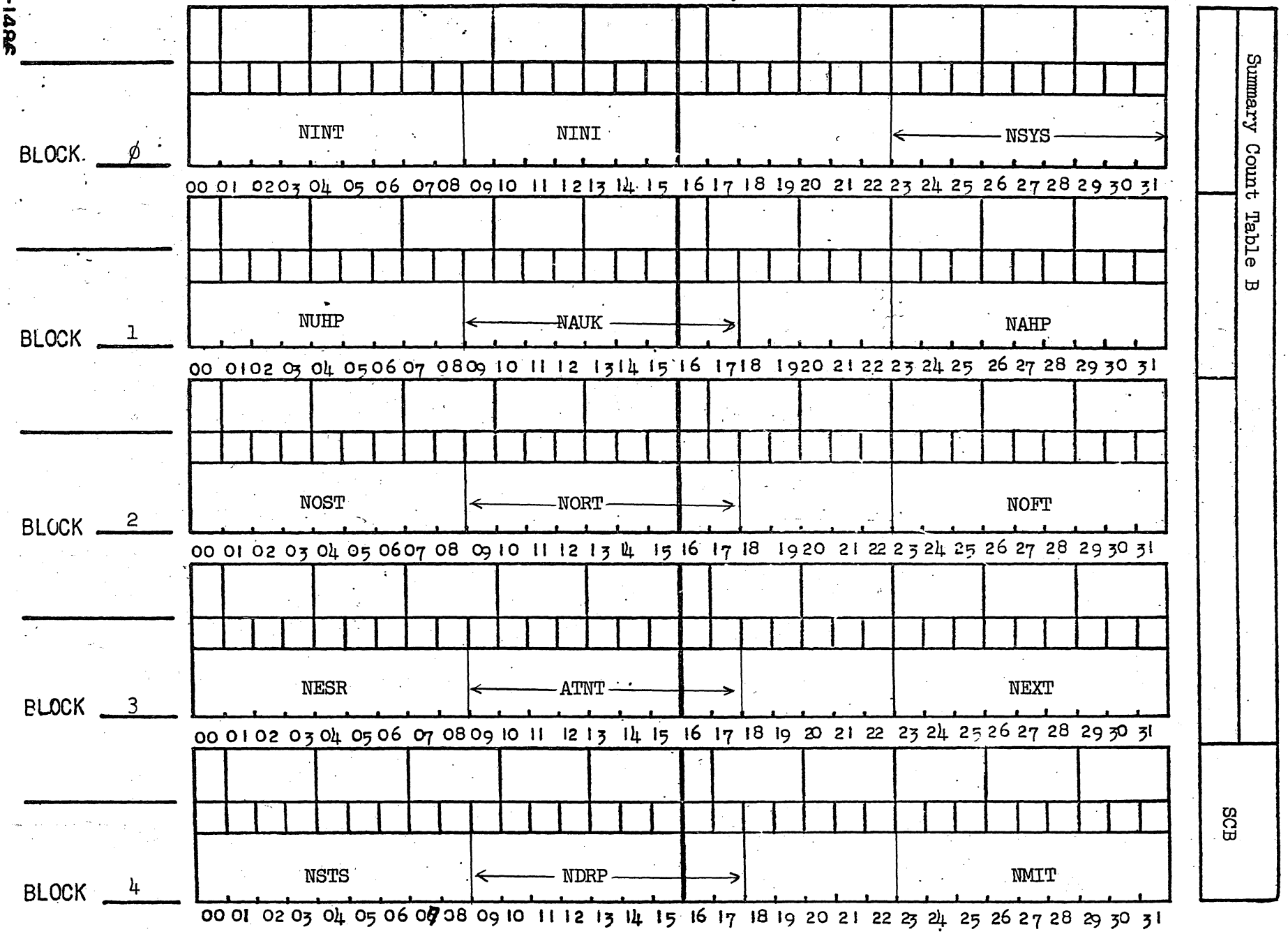
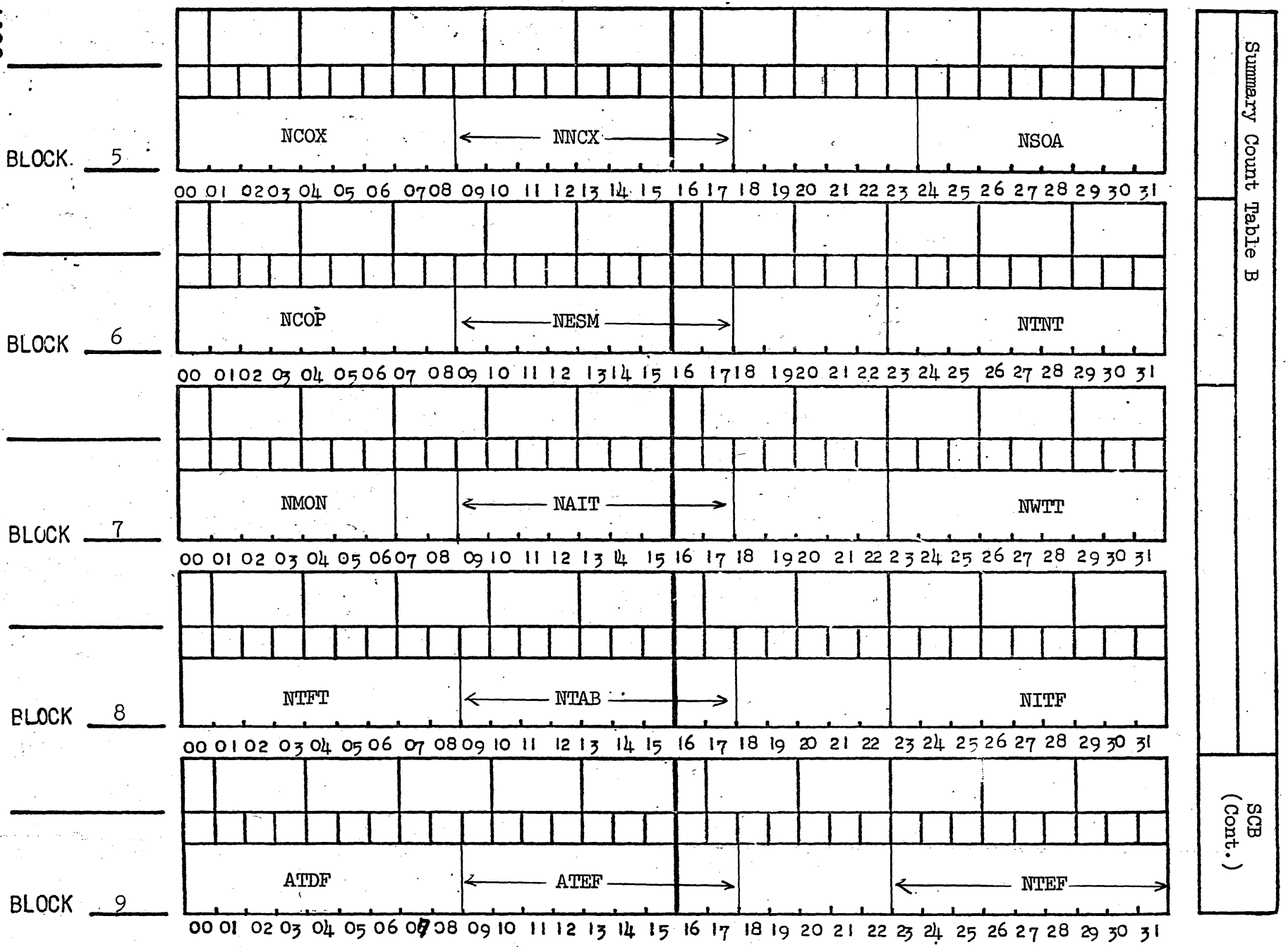
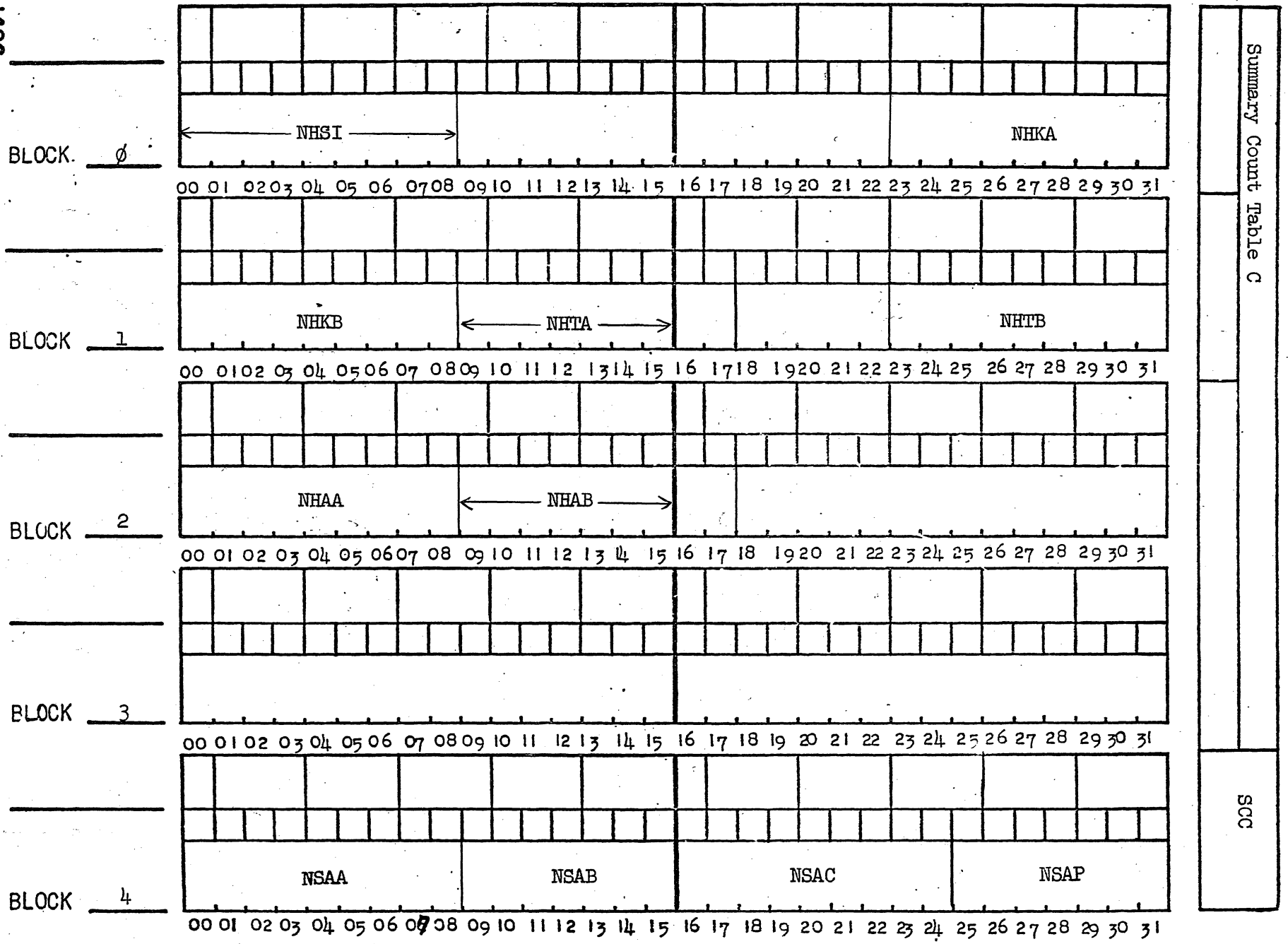
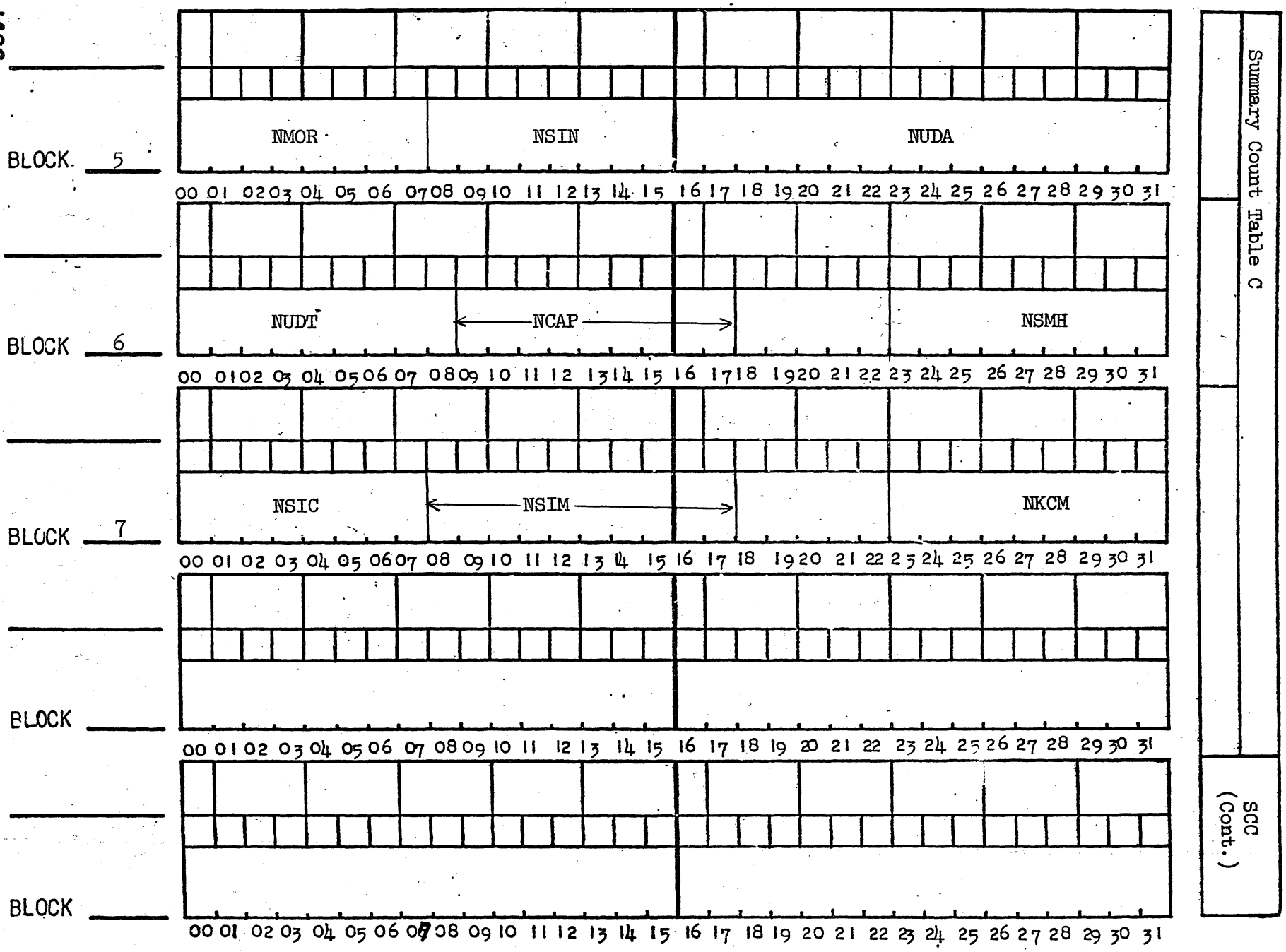
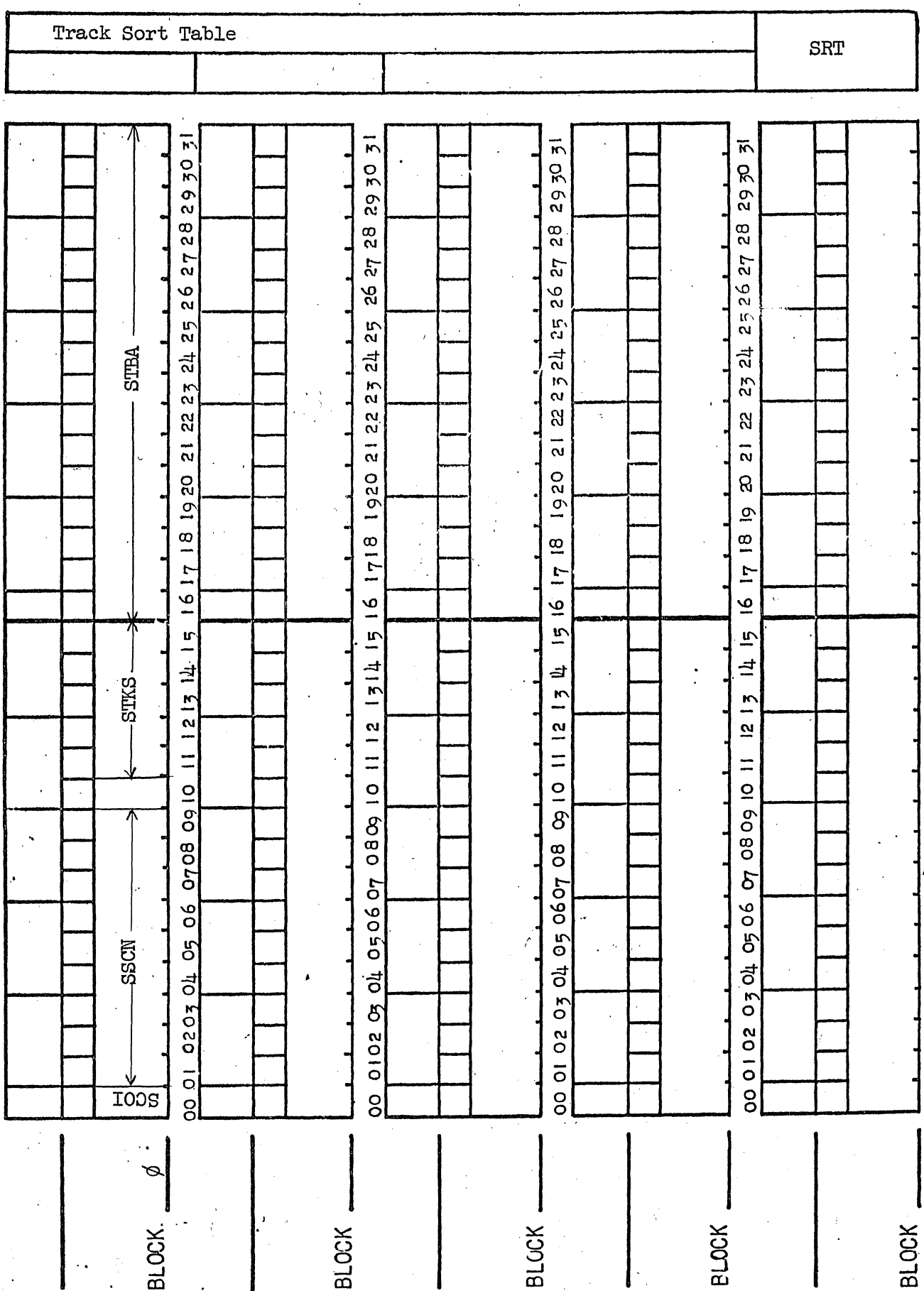

NITS
NUHK
BLOCK. 5
BLOCK
BLOCK
BLOCK
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Summary Count Table A
SCA (Cont.)


BLOCK 0
NINT
NINI
NSYS
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 1
NUHP
NAUK
NAHP
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 2
NOST
NORT
NOFT
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 3
NESR
ATNT
NEXT
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 4
NSTS
NDRP
NMIT
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Summary Count Table B
SCB


BLOCK 5
NCOX
NNCX
NSOA
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 6
NCOP
NESM
NTNT
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 7
NMON
NAIT
NWTT
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 8
NTFT
NTAB
NITF
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 9
ATDF
ATEF
NTEF
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Summary Count Table B
SCB (Cont.)


BLOCK Ø
NHSI
NHKA
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 1
NHKB
NHTA
NHTB
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 2
NHAA
NHAB
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 3
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 4
NSAA
NSAB
NSAC
NSAP
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Summary Count Table C
SCC


BLOCK 5
NMOR
NSIN
NUDA
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 6
NUDT
NCAP
NSMH
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 7
NSIC
NSIM
NKCM
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Summary Count Table C
SCC (Cont.)


Track Sort Table
SRT
STBA
STKS
SSCN
SCOI
BLOCK
BLOCK
BLOCK
BLOCK
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

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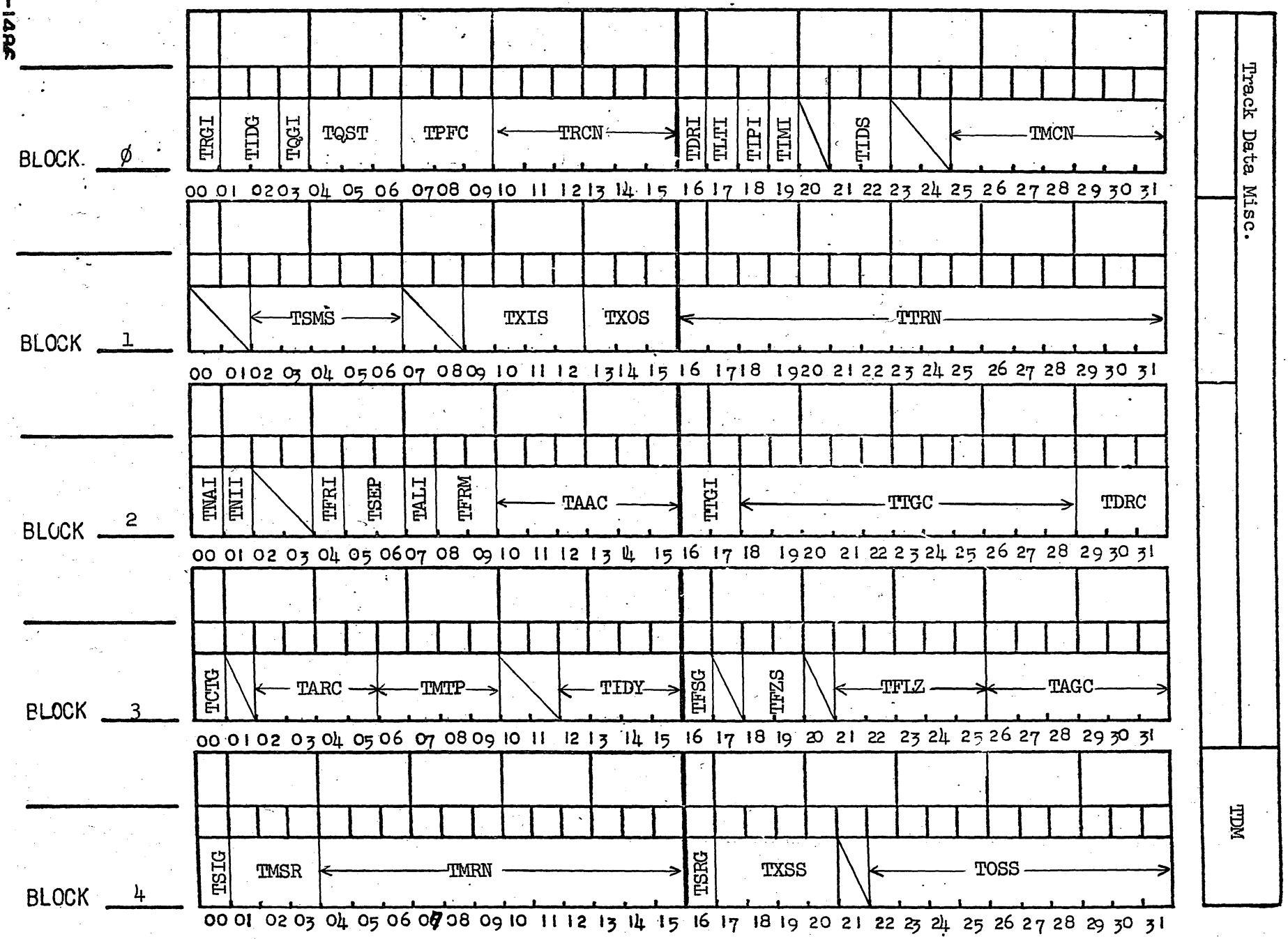
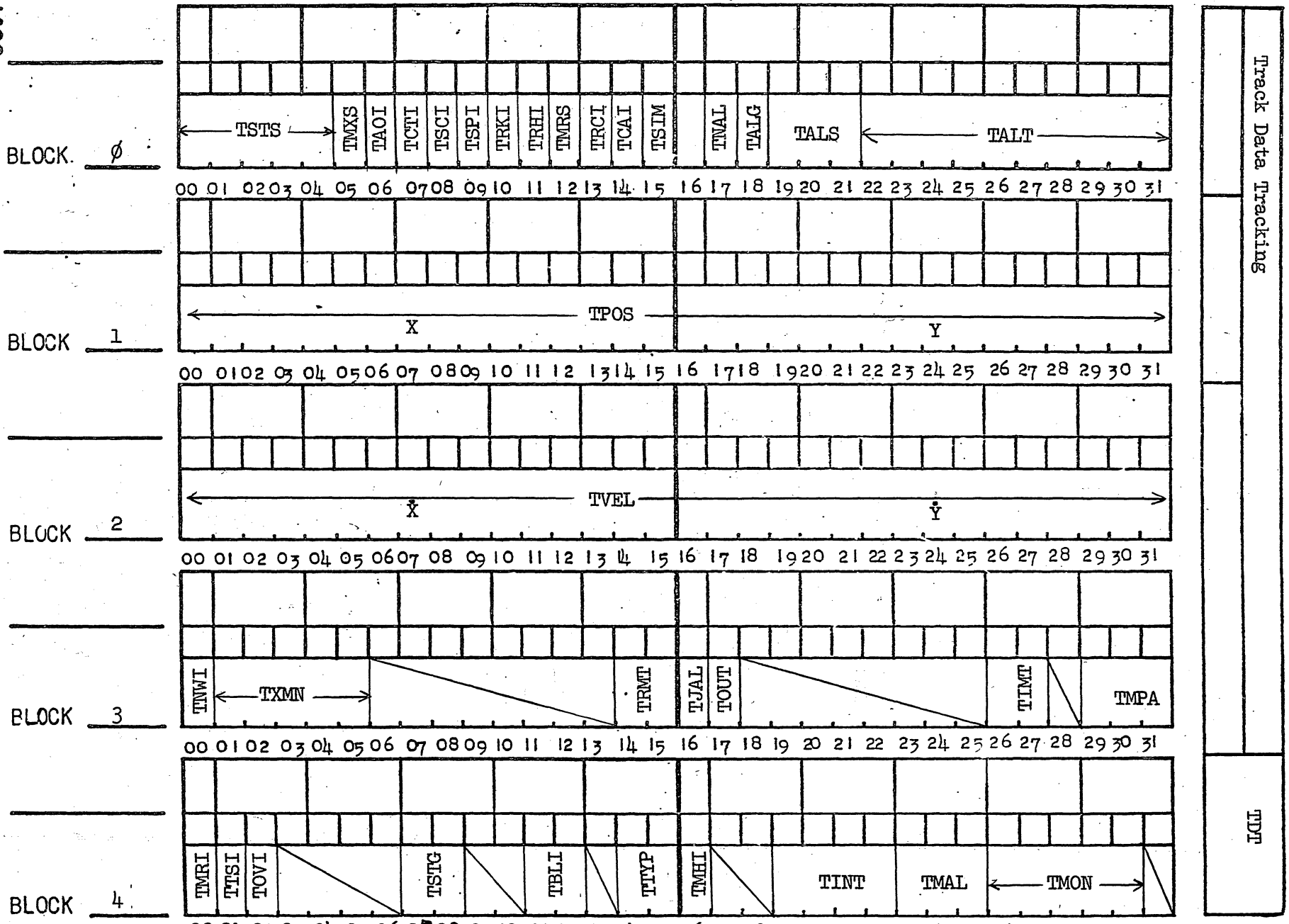
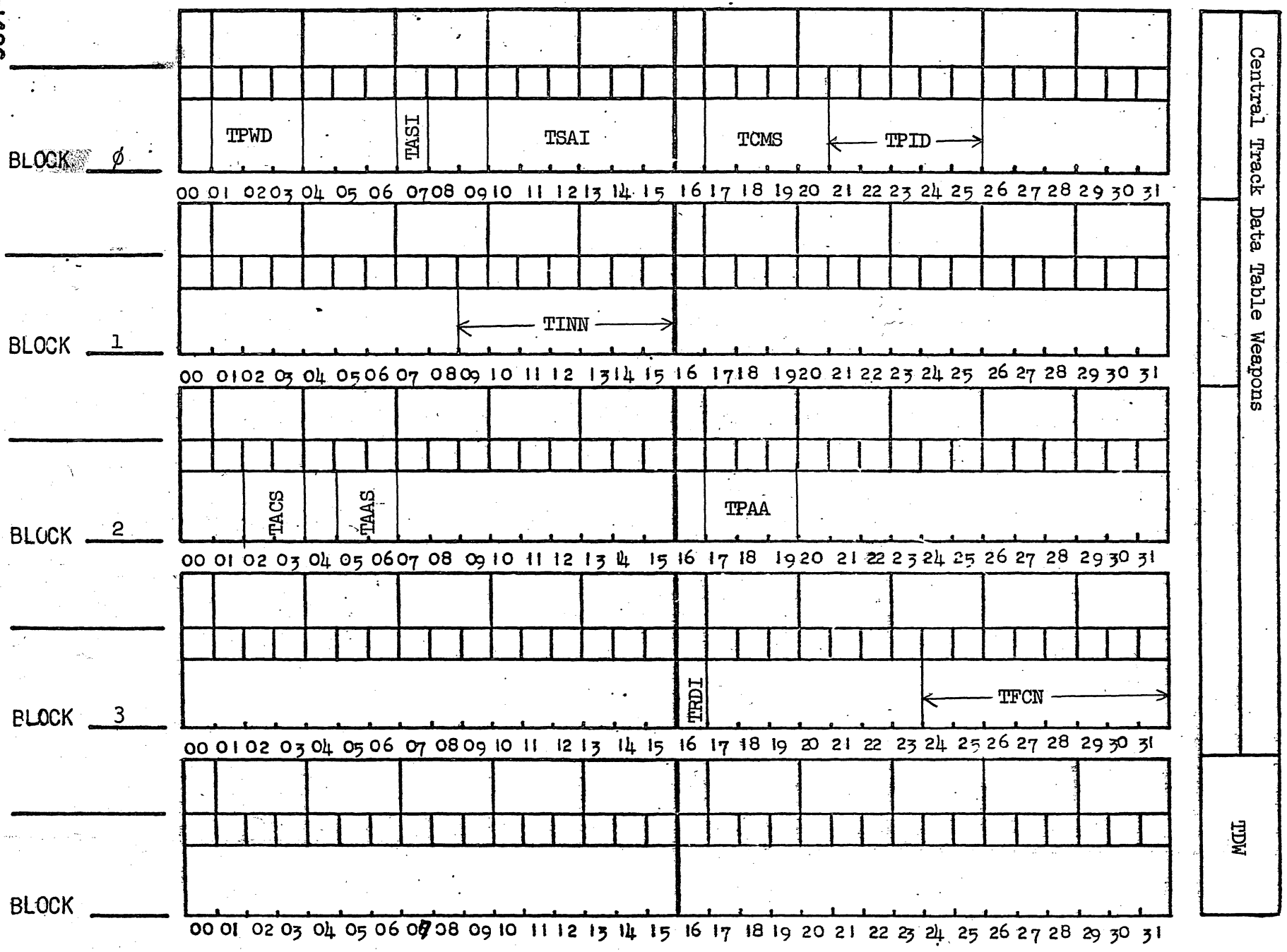

BLOCK. Ø
TRGI
TIDG
TQGI
TQST
TPFC
TRCN
TDRI
TLTI
TPFI
TIMI
TIDS
TMCN
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 1
TSMS
TXIS
TXOS
TTRN
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 2
TNAI
TNII
TFRI
TSEP
TALI
TFRM
TAAC
TTGI
TTGC
TDRC
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 3
TCTG
TARC
TMTP
TIDY
TFSG
TFZS
TFLZ
TAGC
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 4
TSIG
TMSR
TMRN
TSRG
TXSS
TOSS
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Track Data Misc.
TDM


BLOCK Ø
TSTS
TMXS
TAOI
TCTI
TSCI
TSPI
TRKI
TRHI
TMRS
TRCI
TCAI
TSIM
TVAL
TALG
TALS
TALT
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 1
X
TPOS
Y
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 2
Ẋ
TVEL
Ẏ
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 3
TNWI
TXMN
TRMT
TJAL
TOUT
TIMT
TMPA
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 4
TMRI
TTSI
TOVI
TSTG
TBLI
TTYP
TMHI
TINT
TMAL
TMON
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Track Data Tracking
TDT


BLOCK ø
TPWD
TASI
TSAI
TCMS
TPID
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 1
TINN
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 2
TACS
TAAS
TPAA
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK 3
TRDI
TFCN
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Central Track Data Table Weapons
TDW

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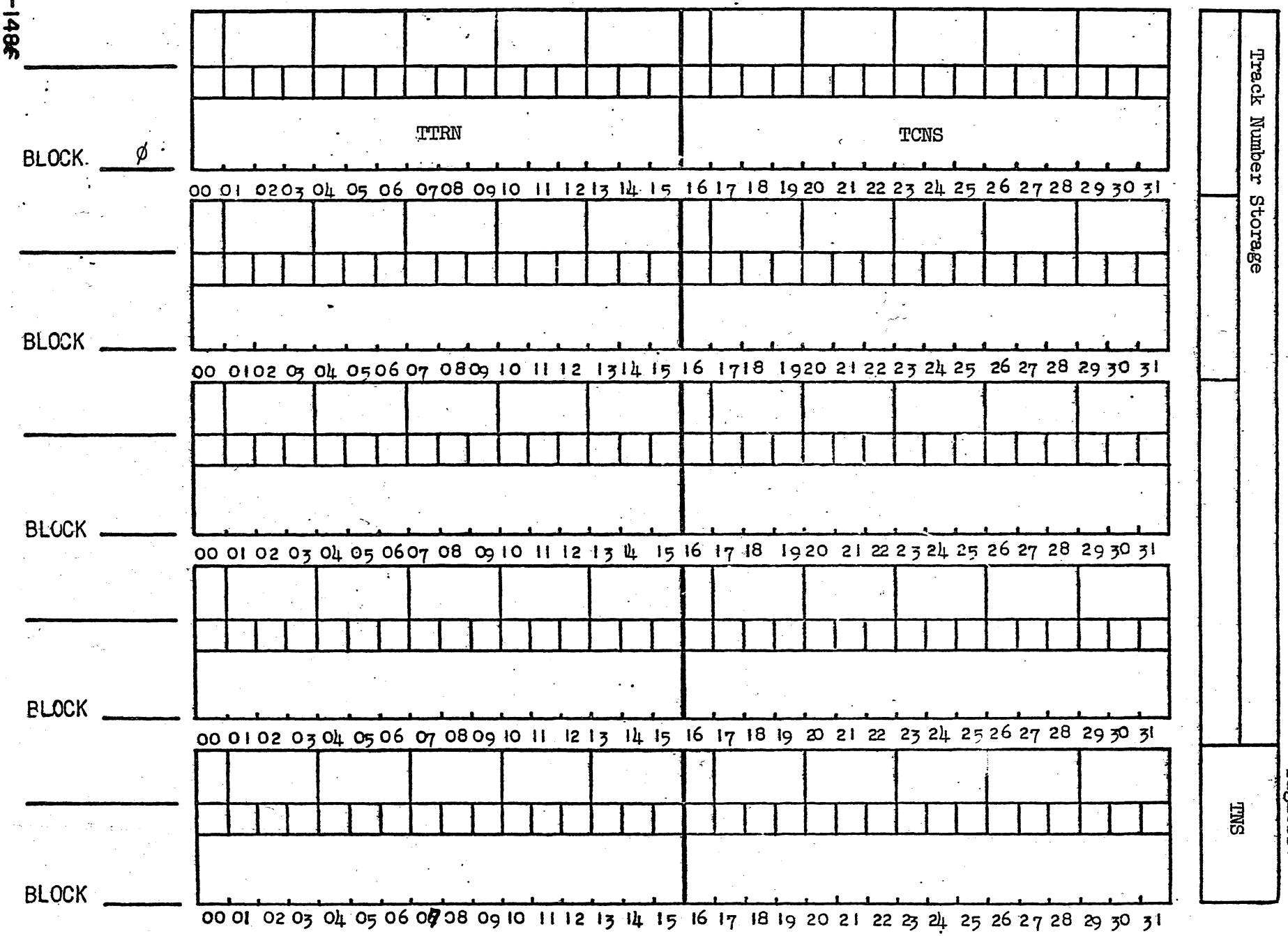

Tagless!

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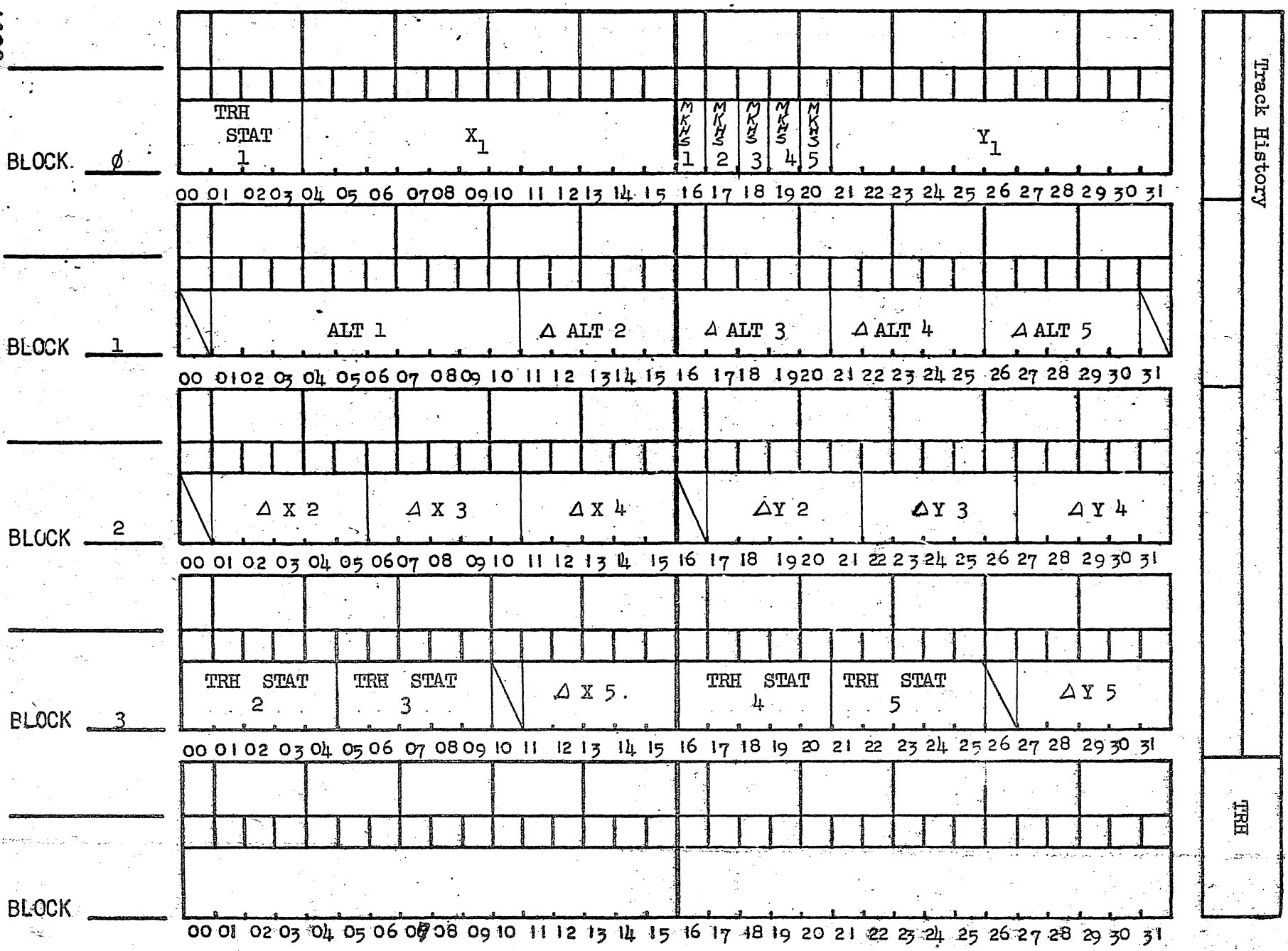

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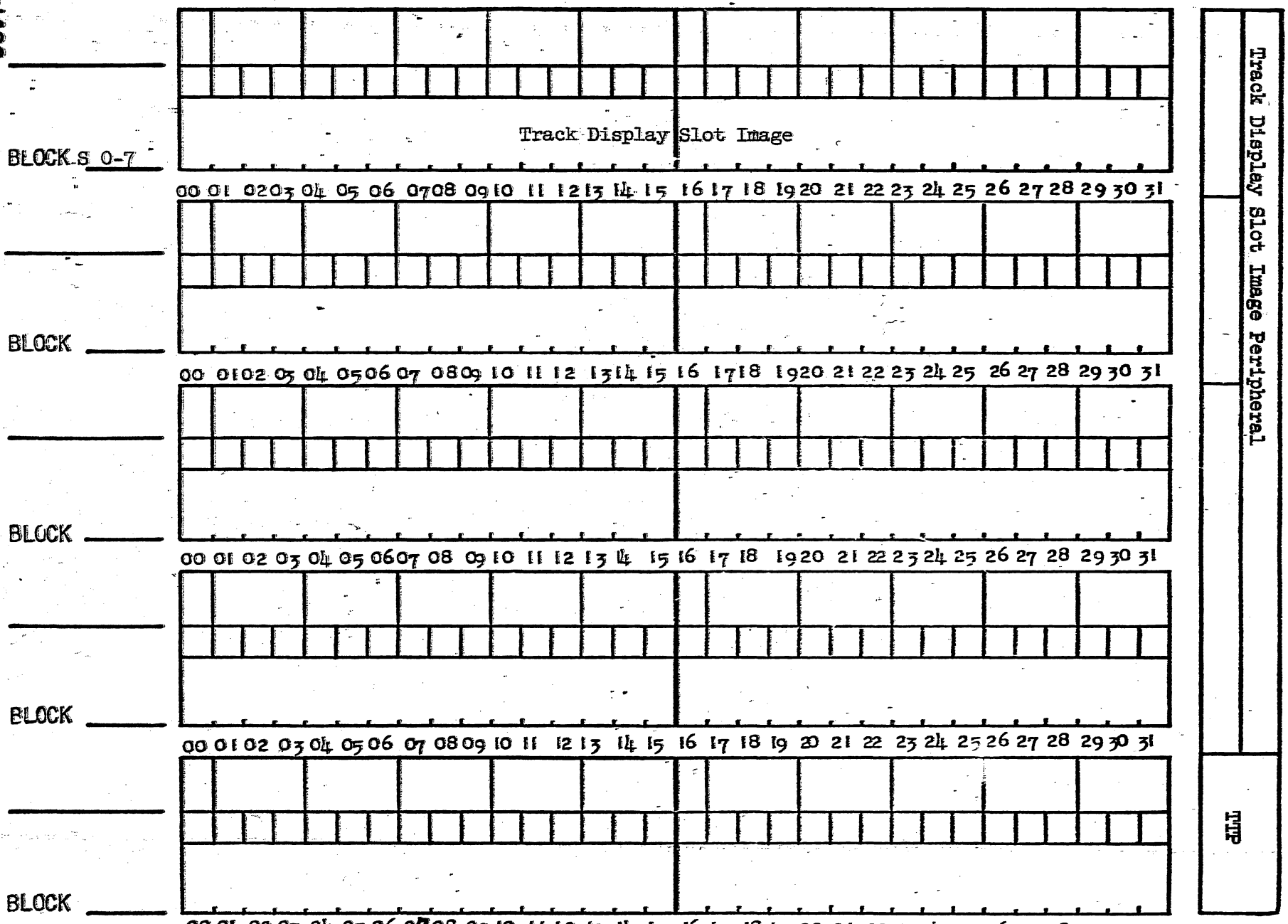
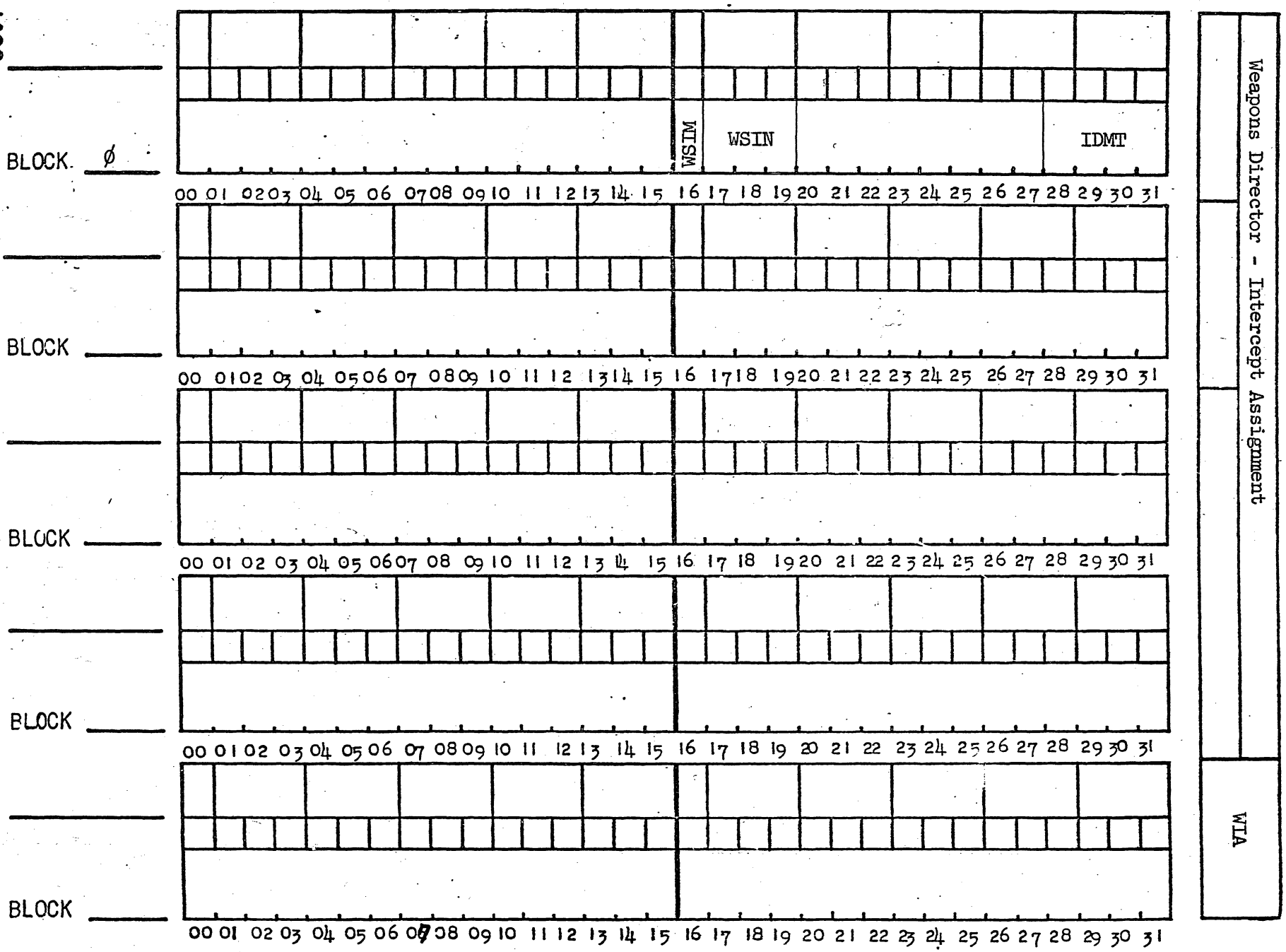

Track Display Slot Image
BLOCKS 0-7
BLOCK
BLOCK
BLOCK
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Track Display Slot Image Peripheral
TTP


BLOCK Ø
WSIM
WSIN
IDMT
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
BLOCK
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Weapons Director - Intercept Assignment
WIA

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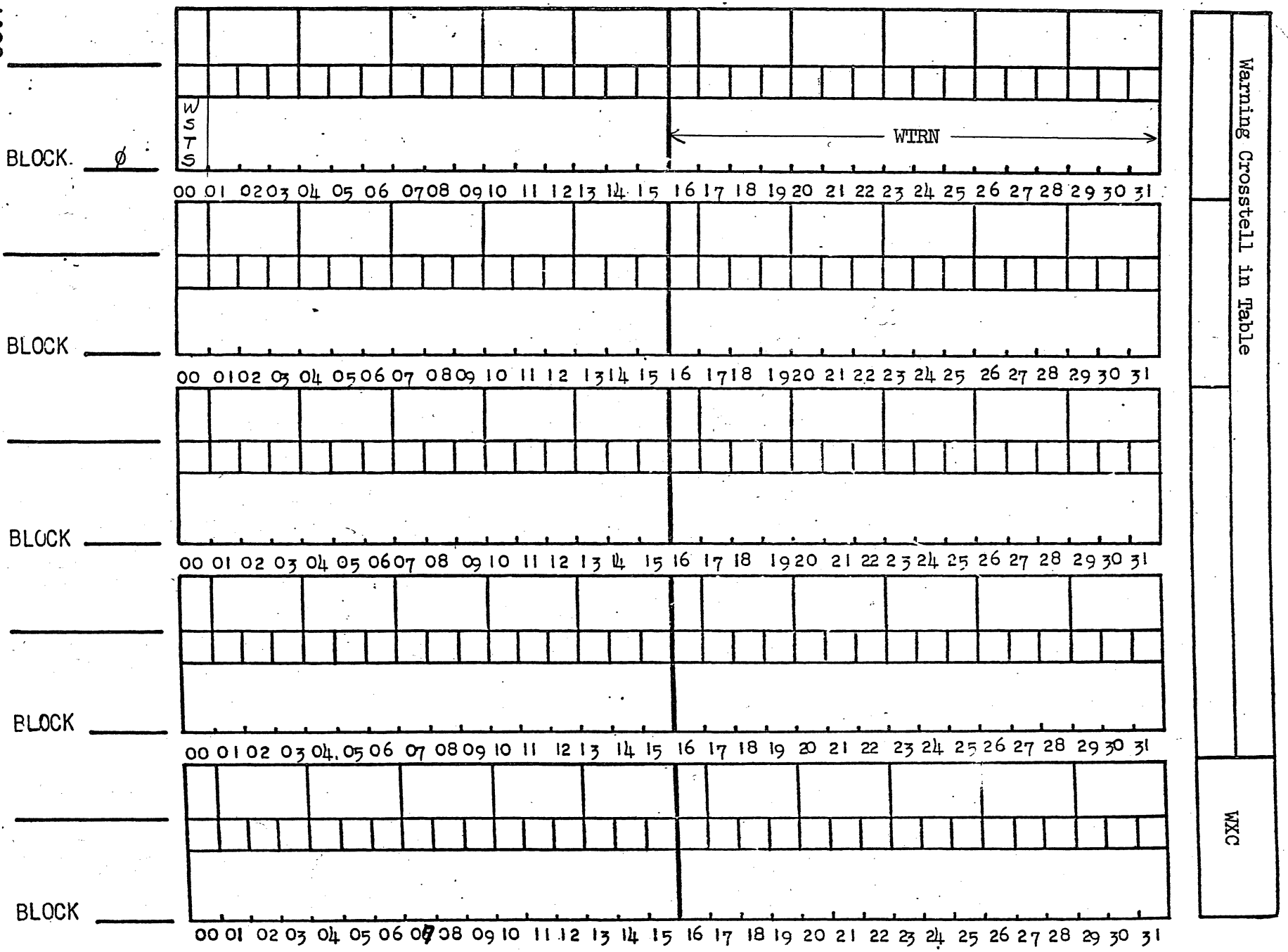

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Item or Table	KST	KSI	TCO	TSA	CTA	CTB	STK	KST	KSI	CTS	TCO	TSA	CTA	STK	CTH	KST	KSI	TCO	TSA	TSD	TSE	TST	CTA	STK
ARIP						S																		
ATDF						S																		
ATEF						S																		
ATEI																				S	B	S		
ATNT						S																		
AUIP						S																		
BDGC					B								B										B	
BNGC					B								B										B	
BPID					B								B										B	
BPWD					B								B										B	
BSGC					B								B										B	
CARA			S	U																	U	B		
CARB											S	U									U	B		
CARC																		S	U		U	B		
CARF																		S	U		B			
CCON	S	S						S	S							S	S							
CDDT	S	S						S	S							S	S							
CFOR		S							S								S							
CIAT	S	S						S	S							S	S							
CLCN		S							S								S							
COAD	U	U	U				U	U	U		U			U		U	U	U						U
COMU	U	U	U				U	U	U		U			U		U	U	U						U
CRCN	S	S						S	S							S	S							
CREF		S							S								S							
CSMT	S	S						S	S							S	S							
CSXX	S	S						S	S							S	S							
CSYY	S	S						S	S							S	S							
CTIP						B																		
DIDT					B								B										B	
DSFI							B							B										B
DSTI				U								U							U	B	B	B		
DSXA			S	U																	U	B		
DSXB											S	U									U	B		
DSXC																		S	U		U	B		
DXSM			S	U							S	U						S	U					
DSYA			S	U																	U	B		
DSYB											S	U									U	B		
DSYC																		S	U		U	B		
DYSM			S	U							S	U						S	U					
FAVC					B								B										B	
FBAR							U							U										U
FDST							U							U										U
FDIT							U							U										U
FEXT	U							U								U				U	U	U		
FMIN							U							U										U
FSTS					B								B										B	
FTCN					B								B										B	

Item or Table	KST	KSI	TCO	TSA	CTA	CTB	STK	KST	KSI	CTS	TCO	TSA	CTA	STK	CTH	KST	KSI	TCO	TSA	TSD	TSE	TST	CTA	STK
GDAI			S	U																	U	B		
GDBI											S	U									U	B		
GDCI																		S	U		U	B		
GDPI																			U		S			
ICMS					U								U										U	
IDIN					B								B										B	
IDMT						U																		
IFCN					U								U										U	
IFLC					U								U										U	
INSC																						B		
IPID					U								U										U	
IPOI						B																		
IPOS					U								U										U	
ITRN					U								U										U	
LCNF		B		B					B			B					B		B					
MISI																					B			
MSGI			U								U							U						
MXCI			B								B							B			U	B		
MXER			S								S							S			B	B		
MXSC																					B	B		
NAHP						S																		
NAIT					B								B										B	
NAUK						S																		
NCAP						S																		
NCOP						S																		
NCOX						S																		
NDRP					S								S										S	
NEHT					B								B										B	
NEMP	S	B		B	S			S	B	S		B	S			S	B		B			S	S	
NESM						S																		
NESR						S																		
NEXT						S																		
NHAA						S																		
NHAB						S																		
NHKA						S																		
NHKB						S																		
NHSI					S								S										S	
NHTA						S																		
NHTB						S																		
NINI						S																		
NINT						S																		
NITF						S																		
NITS					S								S										S	
NKCM						S																		
NMIT						S																		
NMON						S																		
NMOR						S																		

Item or Table	KST	KSI	TCO	TSA	CTA	CTB	STK	KST	KSI	CTS	TCO	TSA	CTA	STK	CTH	KST	KSI	TCO	TSA	TSD	TSE	TST	CTA	STK
NNCX						S																		
NOFT						S																		
NORT						S																		
NOST						S																		
NRIP						U																		
NRSA			S	B							S	B						S	B					
NSAA						S																		
NSAB						S																		
NSAC						S																		
NSAP																								
NSIC						S																		
NSIM						S																		
NSIN						S																		
NSMH						S																		
NSOA						S																		
NSTS						S																		
NSYS					S								S										S	
NTAB						S																		
NTDF	S					U		S		S						S						S		
NTEF					S	U							S										S	
NTFT						S																		
NTNT						U																		
NUDA						S																		
NUDT						S																		
NUHK					B								B										B	
NUHP						S																		
NUIP						U																		
NWTT						S																		
PFCI																					B			
PFRE					U								U										U	
PLFC																				B	B			
PSMI																					U			
PTSI																					U			
RGPS					B								B										B	
RGRN					B								B										B	
SCOI			U							S	U							U						
SEXT	U			U				U				U				U			U	U				
SFTC	U		U	U			U	U			U	U		U		U		U	U					U
SSCN		U	U						U	S	U						U	U						
STBA		U	U						U	S	U						U	U						
STKS										S														
TAAC						B																		
TAAS						U	U							U										U
TACS							U							U										U
TAGC		S				B	U							U			S			U		S		U
TALG							B							B										B
TALI																								

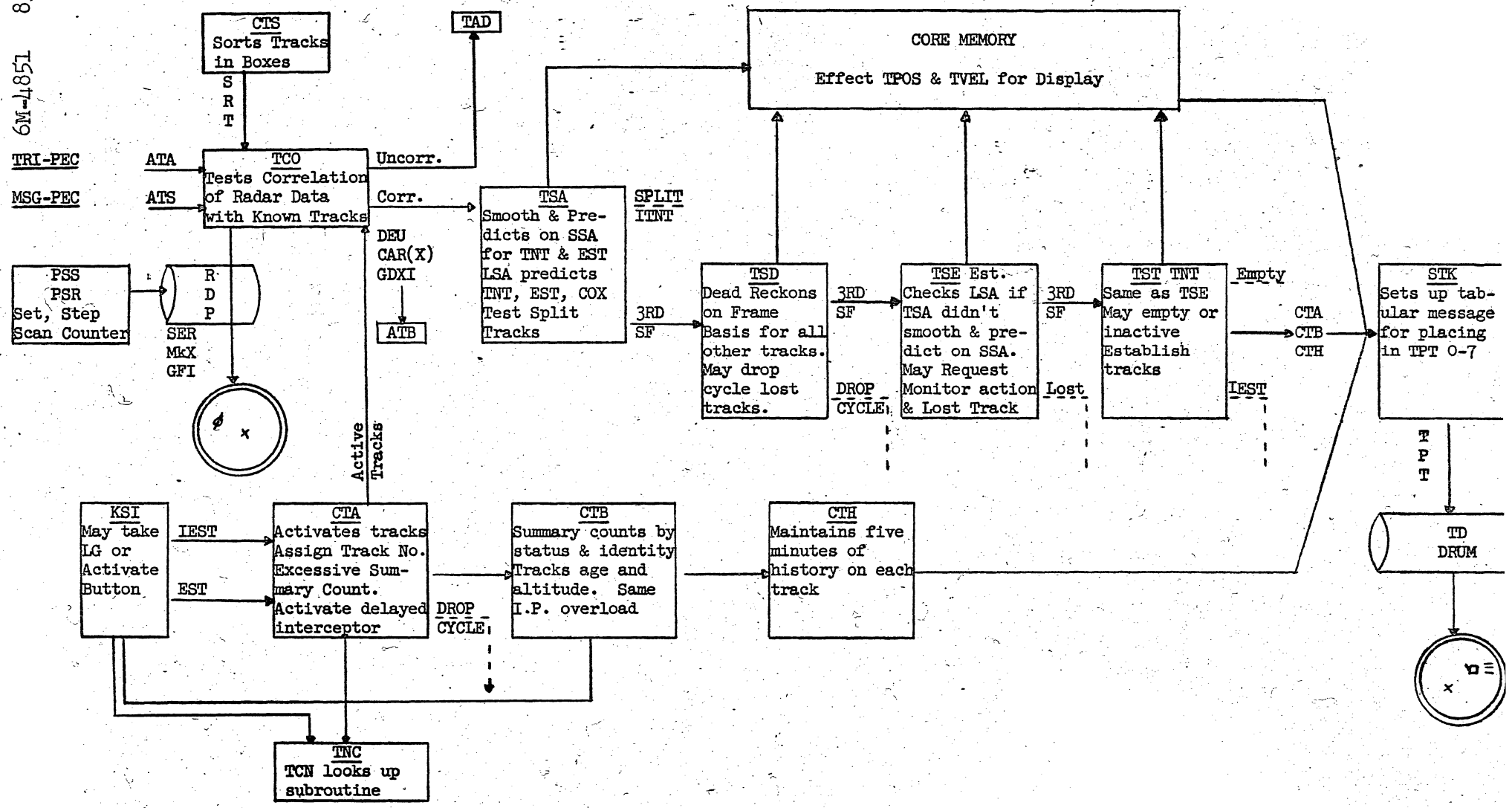
Item or Table	KST	KSI	TCO	TSA	CTA	CTB	STK	KST	KSI	CTS	TCO	TSA	CTA	STK	CTH	KST	KSI	TCO	TSA	TSD	TSE	TST	CTA	STK
TALS							U							U										U
TALT			U				U				U			U	U			U						U
TAOI			U	U						S	U	U						U	U					
TARC																								
TASI					B	U							B										B	
TBLI	S							S								S					B			
TCAI	S							S								S								
TCAP		U															U							
TCMS					B	U	U						B	U									B	U
NSUP						S																		
TCPX			U	U	U	U	U			U	U	U	U	U	U			U	U	U	U	U	U	U
TCTG					S		B						S	B									S	B
TCTI				U			U					U		U					U		U			U
TDRC																								
TDRI					S								S										S	
TFCN					B		U						B	U									B	U
TFLZ					S	U	U						S	U									S	U
TFRI																								
TFRM																								
TFSG																								
TFZS					S		U						S	U									S	U
TIDG					B								B										B	
TIDS					B		U						B	U									B	U
TIDY	U				B	U	U	U					B	U						U			B	U
TIMI																								
TIMT					S	U							S	U								S	S	U
TINN						U								U										U
TINT							U							U										U
TIPI																								
TJAL																				S	S			
TLTI																								
TMAL																								
TMCN																								
TMHI																								
TMON						U																		
TMPA						U								U	U						S			U
TMRI																					S			
TMRN		S							S								S							
TMRS																								
TMSR						U								U	U									U
TMTP																								
TMXS			U				U				U			U	U			U			B	B		U
TNAI																								
TNAL																								
TNII																								
TNWI					B		U						B	U									B	U
TOSS																								

Item or Table	KST	KSI	TCO	TSA	CTA	CTB	STK	KST	KSI	CTS	TCO	TSA	CTA	STK	CTH	KST	KSI	TCO	TSA	TSD	TSE	TST	CTA	STK
TOOT							U							U										U
TOVI																								
TPAA						U	U							U										U
TPFB																					S			
TPID					B		U						B	U									B	U
TPOS	B	B	U	B	B		U	B	B	U	U	B	B	U	U	B	B	U	B	B	B	B	B	U
TPWD					B		U						B	U									B	U
TQGI																								
TQST																								
TRCI			U								U							U					
TRCN																								
TRDI					U								U										U	
TRGI							U							U										U
TRHI					S								S		B								S	
TRKI				U						U		U								U	U			
TRMT	S	S			S	U	U	S	S				S	U	U	S	S				B	S	S	U
TSAI						U																		
TSCI			S								S							S			B		
TSEP																								
TSIG	S	S			S		S	S	S				S	S		S	S				S	S	S	S
TSIM						U															U			
TSMS							U							U										U
TSPI				S	S					U		S	S						S				S	
TSRG	S	S		S	S		B	S	S			S	S	B		S	S		S	S	S	S	S	B
TSTG	S	S		B	B		U	S	S			B	B	U		S	S		B	S	B	B	B	U
TSTS	B	B		B	B	U	U	B	B	U		B	B	U	U	B	B		B	U	B	B	B	U
TTGC																								
TTGI							U							U										U
TTRN		S			B		U		S				B	U			S						B	U
TTSI		U							U								U							
TTYP							U							U							S			U
TVEL	U	S	U	B			U	U	S		U	B		U		U	S	U	B	B	B	B		U
TXIS						B	U							U										U
TXMN																								
TXOS							U							U										U
TXSS							U							U										U
WSIM						U																		
WSIN						U																		
WTRN					B								B										B	
WSTS					B								B										B	

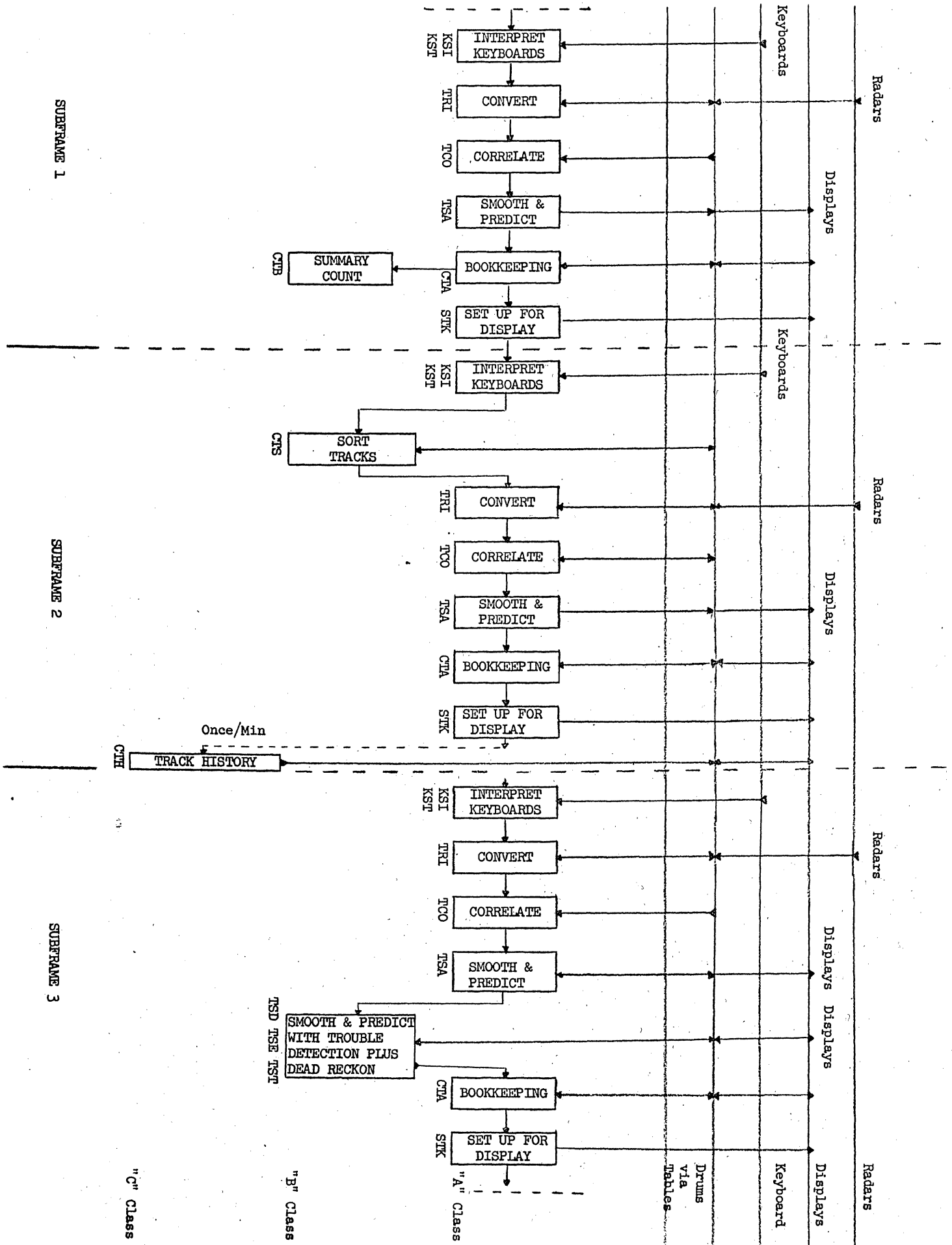
5.3 Necessary Environment for Program Unit Operation

PROGRAM	ENVIRONMENT
KST	PCSØ, PCCØ, LIPØ, LIP1, KIPØ, KIP1, CSAØ, KLG, TNSØ, TNC, TDWØ, TDW1, TDW2, TDW3, TDMØ, TDM1, TDM2, TDM3, TDM4, TDTØ, 1, 2, 3, 4
KSI	PCSØ; PCCØ; SCAØ; ABIØ; LIPØ, 1; KIPØ, 1; CSAØ; SRTØ; TNSØ; TNC; TDM1, 3, 4; TDTØ, 1, 2, 3, 4
CTS	PCCØ; PCSØ; SCAØ; SRTØ; TDMØ, 1, 2, 3, 4; TDTØ, 1, 2, 3, 4
TCO	PCCØ; PCSØ; ATSØ; ATAØ, 1; TCTØ; CORØ; SRTØ; ATBØ, 1, 2, 3; PDPØ, 1; TDTØ, 1, 2.
TSA	PCCØ; PCSØ; ATBØ, 1, 2, 3; TDM4; TDTØ, 1, 2, 4
TSD	PCSØ; ATBØ, 1, 2, 3; TDM3, 4; TDTØ, 1, 2, 3, 4
TSE	PCSØ; PCCØ; CERØ; ATBØ, 1, 2, 3; TDMØ, 4; TDTØ, 1, 2, 3.
TST	PCCØ; PCSØ; CERØ; SCAØ; ATBØ, 1, 2, 3; TDMØ, 1, 2, 3, 4; TDTØ, 1, 2, 3, 4

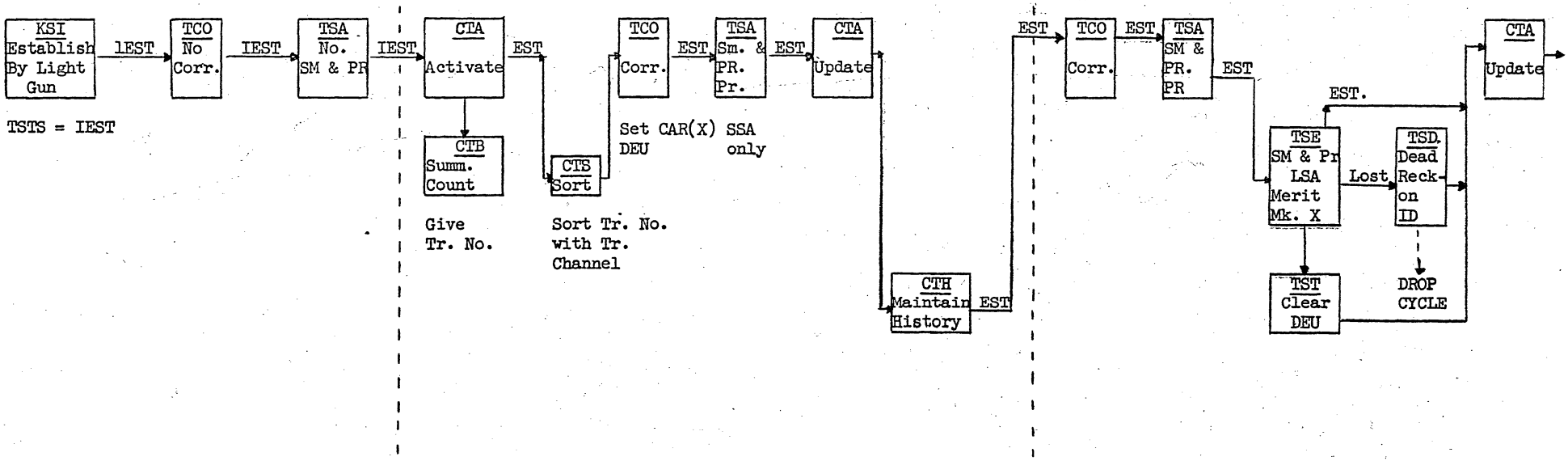
PROGRAM	ENVIRONMENT
CTA	SCCϕ; SCBϕ; SCAϕ; PCCϕ; PCSϕ; RGϕ; CBAϕ; CBAϕ; CDIϕ; FAVϕ; CTIϕ; NAVϕ; TNTϕ; FDCϕ; WXCϕ; TNSϕ; TNC; TDWϕ, 1, 2, 3; TDMϕ, 1, 2, 3, 4; TDTϕ, 1, 2, 3, 4
CTB	SCAϕ; SCBϕ; SCCϕ; PCCϕ; PCSϕ; CBAϕ; FDRϕ; CBIϕ; WIAϕ; TDWϕ, 3; TDM1, 2, 3; TDTϕ, 3, 4
STK	PCCϕ; PCSϕ; DTAϕ; TTPϕ, 1, 2, 3, 4, 5, 6, 7; FDCϕ, 2, 5; DABϕ, 1, 2; TDWϕ, 1, 2, 3; TDMϕ, 1, 2, 3, 4; TDTϕ, 1, 2, 3, 4
CTH	PCSϕ; TRHϕ, 1, 2, 3; TDM4; TDTϕ, 1, 3



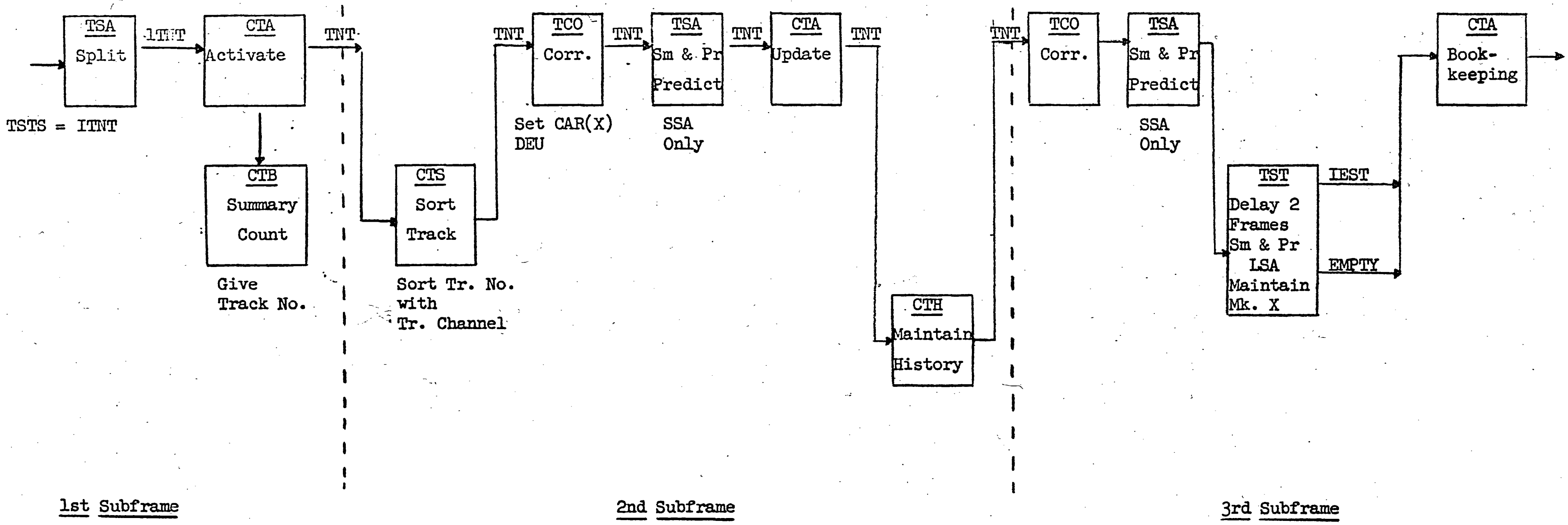
AUTO. TRACKING SYSTEM FLOW

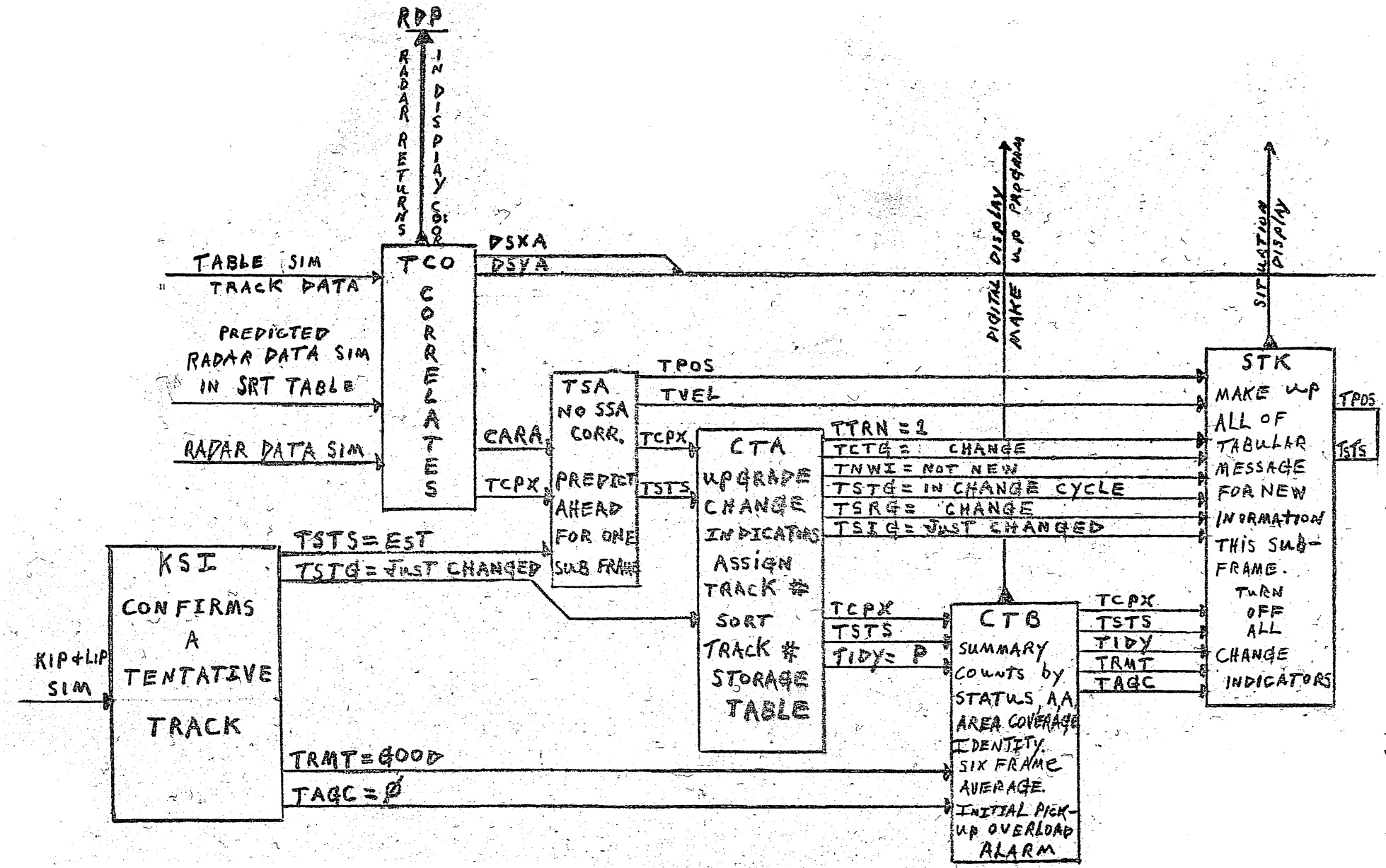

SUBFRAME 1
SUBFRAME 2
SUBFRAME 3
KSI KST
INTERPRET KEYBOARDS
TRI
CONVERT
TCO
CORRELATE
TSA
SMOOTH & PREDICT
CTB
SUMMARY COUNT
CTA
BOOKKEEPING
STK
SET UP FOR DISPLAY
CTS
SORT TRACKS
Once/Min
CTH
TRACK HISTORY
TSD TSE TST
SMOOTH & PREDICT WITH TROUBLE DETECTION PLUS DEAD RECKON
Keyboards
Radars
Displays
Drums via Tables
Keyboard
"A" Class
"B" Class
"C" Class

ESTABLISHED TRACK



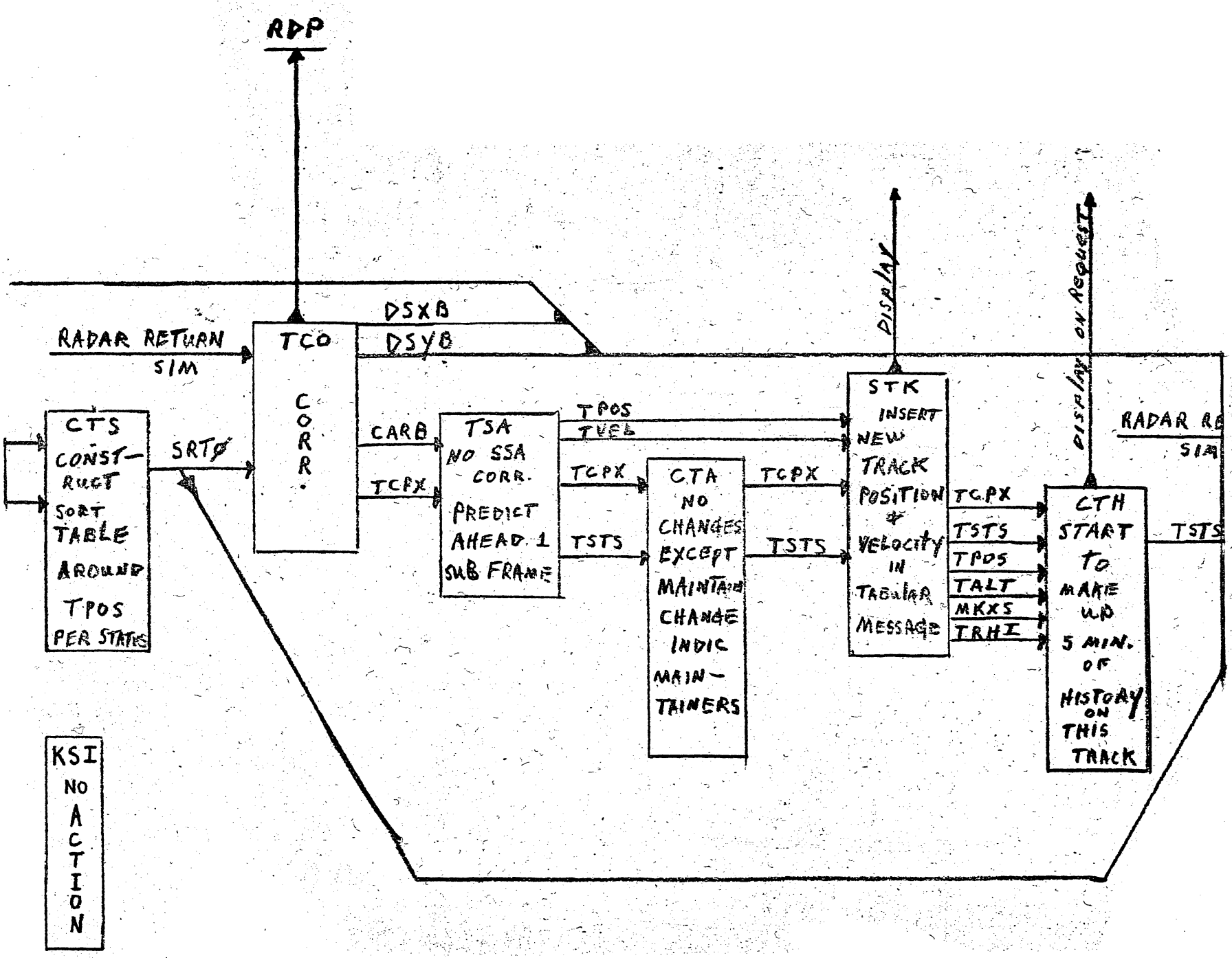
TENTATIVE TRACK



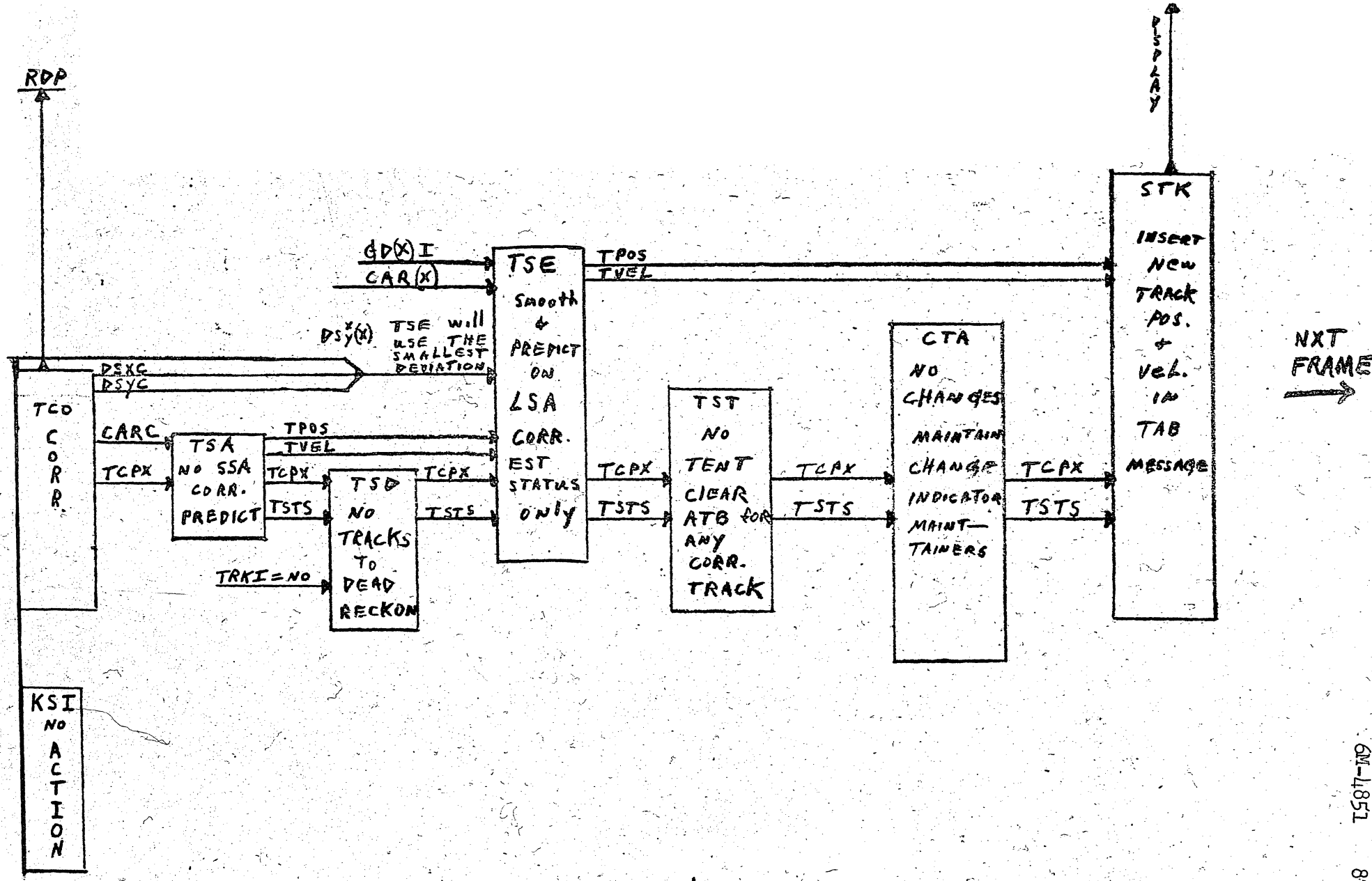


1st SUB FRAME

FOR ASSEMBLY TESTING



GM-18571 87a.



3 Rd

R. E. Bleier
Group 66
12/20/56

6M-4851 87b.

8.0 External and Internal Outputs of the AT Function

8.1 External Outputs

a. STK sets up the 8 word tabular message in preparation for display. PEC places this tabular message on the TD drum, from which it is automatically displayed to personnel concerned.

b. Summary counts are maintained by CTA and CTB for digital display.

c. CTH maintains a continuous five (5) minutes of history for presentation upon request as situation display.

d. Alarm conditions are forced upon certain concerned personnel; i.e. MKX Emergency alarm forced on Tracking Officer, etc.

8.2 Internal Outputs

a. Central Track Data and Track Bookkeeping are calculated and maintained for future recording.

9.0 Glossary of Automatic Tracking Function Terminology

Correlated Radar Data - Data which has been associated with a track or initial pickup.

Crosstell (X-Tell) - The passing of information from one subsector to another.

Command Tracking - An interceptor being vectored by the computer program. Command headings and altitudes being generated on the basis of known speeds and destinations.

Confirm - An action taken by the track initiators to establish a track which had a status of tentative.

Dead Reckon - Predicting a new position based on assigned velocity.

Deviation - Displacement of radar returns from the predicted position measured in terms of X and Y.

Mapping - The elimination, by use of overlays or semiopaque paint, on the Area Discriminator of areas which make automatic detection difficult due to heavy traffic, ground clutter, etc.

Masking - Program selective elimination of returns to reduce data from areas with excessive radar coverage and all data outside the subsector overlap coverage area.

Mark X Emergency Reply - Three or more Mk X replies from a single radar correlating at the same time with any one track will indicate the possibility of an emergency.

Mark X Returns - Particularly reliable radar returns which will be given special priority in tracking.

Mark X Score - A system devised to eliminate the possibility of a non Mk X track crossing MKX data and picking up this new data.

Mark X Track - Tracks which will accept only MKX data for correlation, if such data is available.

Initiation - The culmination of the automatic or manual detection phase when the track becomes established.

Interceptor Delayed - An interceptor which has been scrambled when no empty channels were available in track data central. The computer program will drop Friendlies, Tentatives, Pendings and Fakers in that order to make an empty channel. There is a capacity of four (4) delayed interceptors in the system.

Interceptor, Special - A means of re-identifying Friendly, Round Robin, Special and Faker tracks as interceptors in order to provide the aircraft with vectoring instructions.

Overlap Zone - An area fifteen (15) miles on either side of the subsector boundary used for crosstelling of tracks.

Parameter - A quantity to which the programmer may assign arbitrary values, as distinguished from a variable which can assume only those values that the form of the function makes possible.

Position - The location of the aircraft as projected on an elevated plane (Stereographic projection) measured in terms of X and Y coordinates.

Raid - The combination of a number of hostile tracks with similar velocities and in the same general area for a summary of the air picture for threat evaluation.

Group - The combination of a number of interceptor tracks with similar velocities and in the same general area.

Re-Initiation - Returning to a previously assigned status, such as manually re-establishing tracks with a status of lost or extrapolated. The computer program will not try to correlate data with tracks in these stati, and this function is assumed by the track initiators.

Smooth - Adjustment of track position to compensate for the difference in predicted position and radar returns. Drawing of a forced curve through all past and present positions of this track to most nearly depict the logical path of an aircraft.

Sort Boxes - A system devised to divide the subsector into smaller areas to facilitate correlation.

Status, Inactive - A conditional period in which tracks are placed after a status change in order that the bookkeeping programs may assign track number, up-date information, etc.

Status, Track - A method of determining what type of processing this track requires.

Airborne - Interceptors after they are airborne and prior to initiation. These tracks are extrapolated utilizing their command velocity.

Crosstells, Correlating - Incoming crosstold tracks from an automatic subsector is attempting to correlate with radar data.

Crosstells, Non-Correlating - Incoming crosstold tracks from an automatic subsector which the receiving subsector is not attempting to correlate with radar data.

Drop Cycle - A track about to be dropped from the system is placed into this status for one frame to notify all functions and personnel concerned of the pending action.

Established - All tracks (except TNT, COX) using radar data to estimate position and velocity.

Extrapolated - Hostiles, unknowns, Fakers, and Specials which the AT function can no longer satisfactorily track, but which are required by the Weapons Section.

Lost - Tracks on which the track merit is so poor that the AT function decided that further correlation of radar data is unwarranted. These tracks are predicted ahead utilizing their last known velocity.

Manual Input - Position and estimated velocity reports from external sources (AEW, GOC, Picket Ships, etc.) which are manually inserted into the computer from the manual inputs room. These tracks are predicted along utilizing the estimated velocity for a period of six (6) minutes

between reports, if necessary. Subsequent reports replace the extrapolated positions.

Tentative - A track which is still in the process of automatic detection. At this stage at least two successive radar returns have been received and correlated to indicate the possible existence of a track.

Scrambled - Interceptors which have been scrambled by the weapons section but have not yet reported airborne.

Empty - All tracking channels not occupied by one of the above types.

Track - A collection of data in the computer system intending to represent the position and velocity of one or more aircraft.

Tracking - The actions of collecting and correlating data from radar and other sources to establish or maintain a track.

Track Channel - Numerically identical registers across a group of tables and their blocks containing information on one track. These tables are indexed by TCPX (Track Capacity minus one) and the track channel number corresponds to the value of the index registers used.

Track History - The compilation of track status, position, velocity, altitude, and Mk X status at intervals of one minute, for a continuous total of five minutes of present and past history.

Track Identity - Method of rapidly determining intent of individual aircraft.

Faker - Flights simulating hostile aircraft.

Friendly - Known flights on flights originating in specially designated areas.

Hostile - Flights which are identified as or which clearly exhibit maneuvers indicating destructive intent.

Interceptor - Reserved for fighter type aircraft assigned to intercept or attempt to intercept Hostile, Fakers, or Unknown tracks.

Pending - Flights awaiting identification.

Round Robin - Flights which originate and terminate within the subsector boundaries and whose identification of friendly can be established at initiation.

Special - Flights to which the attention of direction center personnel is specifically directed. This identity includes Fast Freight, Big Photo, Keystone, etc.

Unknown - Flights which cannot be positively identified.

Tracking Merit - An indicator generated by the number of requests for monitoring and during the maintaining of the track in the established status. It requires thirteen (13) frames of poor merit to place a track into lost status. The three levels of merit are good, fair, poor.

Track Number - Numbers assigned to tracks, except interceptors. The number consists of a subsector designation letter and three digits ranging from zero (0) to 699. For interceptors the number consists of two letters for squadron designation and two digits ranging from 1 to 24.

Velocity - A rate of motion in a given direction. A vector, whose direction indicates the course of the aircraft and whose length indicates the speed , measured in terms of X and Y coordinates.

10.0 Simplified Math Specifications for Automatic Tracking Function

10.1 Correlation

In essence, this process entails comparison of the new radar data and the radar data collected from the radar input drums during the past subframe and is performed three times each frame or once every five seconds. This data is not necessarily the radar data seen by the radar set in the past subframe because of a 2 1/2 second time-delay existing between the detection of a target at the site and the transmission of that target to the Direction Center.

Two corrections are necessary to rectify errors existing in the coordinates of the radar return at the time the tracking program receives that return. These corrections are:

1) Correction of slant-range as reported by the AN/FST-2 to the true ground range of the target. It is necessary to know the altitude of the target which is assumed for all radar returns and based on a fixed elevation angle of the antenna (a) for each radar site. The tracking will further correct the reported position when necessary, to reduce the positional error to a maximum of 1/8 mile and will perform this correction on any track lying within 6 nautical miles of the uncorrelated radar return. The following equation is used to compute the slant-range correction:

$$\left.\begin{aligned} X^1 &= X + S \sin\theta \left[1 - \cos\phi - 1/2 \frac{H^2}{S^2}\right] \\ Y^1 &= Y + S \sin\theta \left[1 - \cos\phi - 1/2 \frac{H^2}{H^2}\right] \end{aligned}\right\} \quad 1$$

where X = X-coordinate of return before slant-range correction.

Y = Y-coordinate of return before slant-range correction.

X^1 = X-coordinate of return after slant-range correction.

Y^1 = Y-coordinate of return after slant-range correction.

H = altitude of track, in knots, above radar site.

S = slant-range of track, in knots.

ϑ = elevation angle assumed by radar data input program which supplies cos.

θ = bearing of target from directly above the radar site.

2) Correction of error resulting from time-delay mentioned above and required only when the position error resulting from the delay exceeds 1/8 mile. The correction involves extrapolating the position of the data along the velocity of the track with which it correlates to the middle of the subframe period, ending with the correlation process. This will be done for any track lying within 6 miles of the uncorrected radar return before any further correlation, but after any necessary slant-range correction. The equation for time-delay correction is as follows:

$$\left.\begin{aligned} X^1 &= X + XT_d \\ Y^1 &= Y + YT_d \end{aligned}\right\} \qquad 2$$

where X = X-coordinate of radar return after slant-range correction.

Y = Y-coordinate of radar return after slant-range correction.

X^1 = X-coordinate of radar return after time-delay correction.

Y^1 = Y-coordinate of radar return after time-delay correction.

X = X-component of track velocity.

Y = Y-component of track velocity.

T_d = Time delay from detection of return to one-half subframe before correlation process. (2 1/2 sec.)

(NOTE: The above corrections will be performed before any correlation begins.)

There are two search areas associated with each track. These search areas are bounded by a pair of concentric circles centered on the predicted track position (the position at which the computer expects to find radar data). The small search area, the area bounded by the inner circle, is of such a size as to encompass all radar returns that might be expected from an aircraft flying a straight-line path and has a radius of one mile. The large search area is sufficiently large to permit an aircraft to make a reasonable maneuver, the data to be missing for one frame, and the data on the following frame to lie within the large or small search area. This large search area (L.S.A.) has a radius of 5 miles.

Any radar data which lies within either the large or small search area associated with an established, tentative, or correlated crosstell track is said to be correlated with that track and is displayed as such. The following information is stored within the computer and is accessible at the end of each subframe.

1) The number of data correlated in the small search area.

2) The vector $\Sigma\vec{D}$ (sum of the deviations in the small search area) whose components are defined by the following equations:

$$\left.\begin{aligned} \Sigma D_x &= \sum_{i=1}^{n} (x_i - x_t) \\ \Sigma D_y &= \sum_{i=1}^{n} (y_i - y_t) \end{aligned}\right\} \qquad 3$$

where x_t = x-coordinate of predicted track position.

y_t = y-coordinate of predicted track position.

x_i = x-coordinate of the ith return in SSA.

y_i = y-coordinate of the ith return in SSA.

'n' is programmed as to never exceed 15 and ΣD_x or ΣD_y will ever be greater than 15 knots and any excess to be ignored. The minimum increment for ΣD_x and ΣD_y is 1/16 knot.

Also, at the end of the subframe, certain information will be available concerning data collected in the LSA:

1) A single vector measurement representative of the present location of the track. The components of this vector are:

$$\left.\begin{aligned} D_x &= X_m - X_t \\ D_y &= Y_m - Y_t \end{aligned}\right\} \qquad 4$$

where m is chosen such that,

$$(x_m - x_t)^2 + (y_m - y_t)^2 \leq (x_i - x_t)^2 + (y_i - y_t)^2 \qquad 5$$

or the least distant from the predicted track position of the i's., and where $(X, Y)_T$ and $X, Y)_i$ are denoted in the same manner as in equation (3).

2) An indication of the spatial distribution of the data in the LSA is also available and is considered 'good' if all data collected in LSA satisfy the following equation:

$$(X_n - X_{k\,1})^2 + (Y_n - Y_{k\,1})^2 \leq k^2 \qquad 6$$

where n = the value of (m) which satisfies equation (5) for the first k returns correlated in the track's large search area during this subframe.

R = one mile.

10.2 Subframe Processing

Once each subframe following the correlation process for that subframe, the position of a track will be predicted to a time corresponding to the middle of that subframe. By predicting to the middle of the subframe, the error in the initial association of a return with a track (before time-delay correction) is minimized.

This prediction is performed by taking the 'present' track position and extrapolating it along the 'present' track velocity.

$$\left.\begin{aligned} X_{n+1} &= X_n + \dot{X}_n T \\ Y_{n+1} &= Y_n + \dot{Y}_n T \end{aligned}\right\} \qquad 7$$

where X_n, Y_n = components of 'present' position

$\dot{X}_n$, $\dot{Y}_n$ = components of 'present' velocity

X_{n+1}, Y_{n+1} = components of predicted position

T = deviation of a subframe (5 sec.)

Where there has been no data correlated in the small search area during the past subframe, the present velocity remains unchanged from the most recent previous calculation, and the present position is the position just used for correlation. If data has been collected in SSA during the last correlation, the quantities of equations (3) are used to compute corrected values for the present position and velocity. These values are then used in equations (7) to predict the position.

$$\left.\begin{aligned} X_n &= X_p + a\frac{\Sigma D_x}{n} \\ Y_n &= Y_p + a\frac{\Sigma D_y}{n} \end{aligned}\right\} \quad 8$$

$$\left.\begin{aligned} \dot{X}_n &= \dot{X}_{n-1} + \frac{\phi D_x}{n} \\ \dot{Y}_n &= \dot{Y}_{n-1} + \frac{\phi D_y}{n} \end{aligned}\right\} \quad 9$$

where D_x, D_y, n = terms defined in equations (3)

X_p, Y_p = predicted position used in last correlation.

$\dot{X}_{n-1}$, $\dot{Y}_{n-1}$ = most recently computed velocity (miles per frame)

X_n, Y_n = present position

$\dot{X}_n$, $\dot{Y}_n$ = present velocity

a = 5/16, positional smoothing constant

ϕ = 1/16, velocity smoothing constant

10.3 Frame Processing

The complete radar picture for each track is examined once each frame. There exists four possibilities:

1) Data has been correlated within the small search area during the past frame.

2) No data has been correlated during the past frame.

3) Data has been correlated only within the large search area during the past frame, but this data cannot be used for correcting position and velocity.

4) Data has been correlated only within the large search area during the past frame, and this data will be used for correcting position and velocity.

Situations 1) and 2) are self explanatory. There will be no change in the track position and velocity as computed in the last subframe processing. Situation 3) occurs when the deviations D_x and D_y fail to have good distribution. When the distribution is good, situation 4) holds. Situation 3) is similar to 1) and 2) in that the track positions and velocities are not changed from the values computed in the last subframe processing.

Situation 4) is divided into two possibilities depending on the tracking merit. When the tracking merit is good or fair, the following equations will be used to correct the track's position and velocity.

$$\overline{r}_n = \overline{v}_p + a_1 \left(\frac{\overline{V} \cdot \overline{D}}{|\overline{V}|}\right)\left(\frac{\overline{V}}{|\overline{V}|}\right) + a_2 \left(\frac{\overline{V} \times \overline{K} \cdot \overline{D}}{|\overline{V}|}\right)\left(\frac{\overline{V} \times \overline{K}}{|\overline{V}|}\right) \qquad 12$$

$$\overline{V}_n = \overline{V}_{n-1} + \gamma_1 \left(\frac{\overline{V} \cdot \overline{D}}{|\overline{V}|}\right)\left(\frac{\overline{V}}{|\overline{V}|}\right) \gamma_2 \left(\frac{\overline{V} \times \overline{K} \cdot \overline{D}}{|\overline{V}|}\right)\left(\frac{\overline{V} \times \overline{K}}{|\overline{V}|}\right) \qquad 13$$

where $\overline{D} = \overline{D}_x + \overline{D}_y$ (choice described below),

a_1, a_2 are positional smoothing constants, described below,

α_1, α_2 are velocity smoothing constants, described below,

$\overline{r}_p = X_p + Y_p$, predicted position used in correlation of the subframe from which D_x and D_y are chosen,

$\overline{r}_n = X_n + Y_n$, present position,

$\overline{V}_{n-1} = \overline{V} = \dot{X}_{n-1} + \dot{Y}_{n-1}$, the last computed velocity in miles per frame,

$\overline{V}_n = \dot{X}_n + \dot{Y}_n$, the present velocity in miles per frame, and

$\overline{K}$ a unit vector perpendicular to the X-Y plane.

There are up to three sets of D_x, D_y (from equation (4), one from each subframe, along with associated distribution indicators. D_x and D_y (whose sum is D) will be chosen from one of the subframes as follows:

1) The data distribution associated with the chosen D_x and D_y must be "good,"

2) The magnitude of the $\overline{D}$ chosen must be <u>less</u> than the magnitude of $\overline{D}$ from any other subframe,

and 3) <u>If</u> the tracking merit is "good," D_x and D_y must lie in the area bound by the following equations:

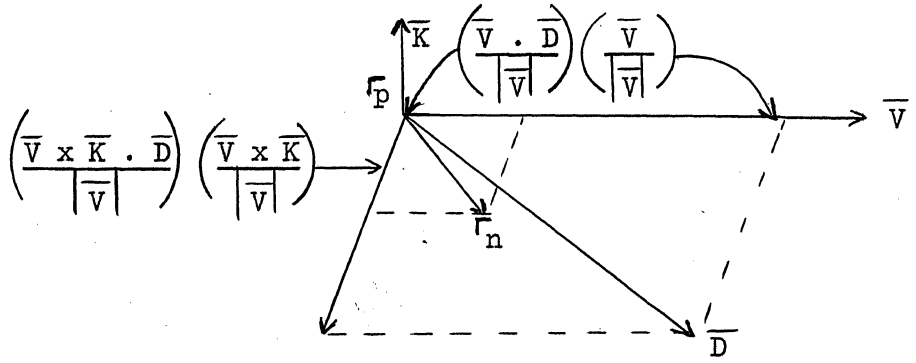
$$\left.\begin{aligned} |\overline{V} \cdot \overline{D}| &\leq |\overline{V}| \ (1/2\ |\overline{V}| + 1) \\ \text{and } |\overline{V} \times \overline{K}| \cdot \overline{D}| &\leq |\overline{V}| \ (|\overline{V}| + 1) \end{aligned}\right\} \qquad 14$$

where the symbols have the same meaning as in equations (12) and (13).

If no D can be found that satisfies the above equations and conditions, the situation reverts to type (3) above.

Equations (14) essentially define a rectangle whose center is the track position and two of whose sides are perpendicular to the velocity vector. The perpendicular sides have a length that is equal to two times the absolute value of the velocity (in miles/frame) plus two miles. The other two sides are equal to a half of above described quantity. If the radar return from which D is derived does not fall within this rectangle, then this situation reverts to type (3).

Equation 12 breaks down as follows:



where $\left(\frac{\overline{V}\cdot\overline{D}}{|\overline{V}|}\right)\left(\frac{\overline{V}}{|\overline{V}|}\right)$ is the component of $\overline{D}$ in the direction of the last computed velocity, and $\left(\frac{\overline{V}\times\overline{K}\cdot\overline{D}}{|\overline{V}|}\right)\left(\frac{\overline{V}\times\overline{K}}{|\overline{V}|}\right)$ is the component of $\overline{D}$ in a direction perpendicular to the last computed velocity in the horizontal plane. These are weighted in the sense that it is more likely that the plane has changed direction rather than increased or decreased its speed.

Equation (13) can be similarly interpreted.

The smoothing constants a_1, a_2, α_1 and α_2 assume the following values:

$$a_1 = 5/16 \ (1/16 - 15/16, \ 1/16)$$

$$a_2 = 9/16 \ (1/16 - 15/16, \ 1/16)$$

$$\alpha_1 = 1/16 \ (1/16 - 15/16, \ 1/16)$$

$$\alpha_2 = 1/4 \ (1/16 - 15/16, \ 1/16).$$

When the tracking merit is poor, a_1 is set equal to a_2 (9/16) and α_1 and α_2 are set to 1/8. The equations (12) and (13) then reduce to

$$\bar{r}_n = \bar{V}_p + a\bar{D} \qquad 10$$

and

$$\bar{V}_n = \bar{V}_{n-1} + \alpha\bar{D} \qquad 11$$

Since the merit is poor, $\bar{D}$ does not have to fall within the rectangle defined by equations (14). The symbols have the same meaning as (12) and (13).

With the new $\bar{r}_n$ and $\bar{V}_n$ determined by equations (10) and (11) or (12) and (13), a new predicted position is determined by equation (7).

Signed: Robert E. Bleier
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