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MISSION 7107

COMMAND and D.L. SYSTEM OPERATION

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TEXT OUTLINE

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MISSION 7107 COMMAND and D.L. SYSTEM OPERATION

I GENERAL

The command system for the 170 Series has remained basically the same as previous Missions. The only changes have been in the areas of increased redundancy to eliminate critical paths and increased command capability commensurate with the increase in Mission requirements.

II BASIC SYSTEM DESCRIPTION

General -

The basic command and D.L. Band Control System is shown functionally in Figure 1. The System consists of receivers, decoders, D.L. System Timer and D.L. Control Subsystems consisting of remote command and telemetry multiplexers.

The command decoder is a high alphabet, multitone system. The message encoding technique involves both the frequency and time domains. The basic system uses eight tones (frequencies) chosen from an alphabet of 12 frequencies (See Appendix A). The command decoder accepts these tones as sequential tone pairs in a digital format. A payload is addressed by a sequence of four tone pairs that must be received within a 3-sec. window which starts with receipt of the first tone pair (Figure 2). Each payload of a Mission has a different address sequence. One of the address tone frequencies is unique to each payload, i.e., P in 171, Q in 172, R in 172

and S in 174. With the constraint that one of the 8 tones is unique to each payload, we have $\frac{7!}{2\,(7-2)!} = 21$ possible tone pairs per payload and $\frac{(21)!}{(21-4)!} = 14{,}364$ possible address sequences. Once the payload command system has been enabled, functional commands can be sent until the system is either reset or executed. A more detailed discussion of the actual commanding operation is included in a later Section.

To enhance the operational life, the systems consists of dual command receivers, demodulators, and logic decoders (Figures 1 & 3). This system is configured such that either receiver can drive either tone demodulator with the other receiver either open or shorted. All of the tone, filter-deciders are redundant and can drive either logic decoder. In addition to being redundant, the entire system is cross coupled which allows receiver #1 and tone-decider bank #2 to work with logic decoder #1. In addition, many critical operational commands are completely redundant.

Command outputs from the decoder logic go to the D.L. System programmable timer and to the D.L. control subsystems.

The D.L. system programmable timer is the same as in Mission 160. It allows for delayed execution of all D.L. commands in 10-minute increments up to 140 minutes and a selectable 50 minutes or 20 minutes D.L. system "ON" time. Its operation starts with the Execute Command KI.

The D.L. control subsystems accept all commands for the D.L. bands providing for remote command multiplexing of the commands and configuration control of all bands.

As many bands have commandable options, it was necessary to provide increased command capability. This was accomplished through the use of a command multiplexer which is an integral part of the D.L. control subsystem. Through the use of an advance or repeat tone pair, each D.L. command provides five additional commands. This will be covered in detail in a following Section. The control subsystem provides for complete control over the down-link routing, SLM option, etc., of each band. The system also contains (Figure 1) a remote P.C.M. telemetry multiplexer for monitoring the status and configuration of each band.

Detailed -

a. Receiver - Tone Filter Decider -

The payload command receiver system consists of two single conversion AM receivers driving two redundant filter banks, each consisting of eight (8) "Noise Immune" filters. Tones in the filter pass band produce a positive output and activate the tone decider. Tones outside the passband produce a negative output giving rise to the term "infinite" adjacent channel rejection. Likewise, noise produces a net negative voltage and hence, the term "Noise Immune." The filters are coupled double tuned circuits whose output drive Schmitt-shots. After the input signal level passes the decider or schmitt-shot input threshold, the circuit regeneratively triggers, staying on for approximately 60 ms following the end of the input tone burst. The tone pair timing is shown in Figure 2.

b. Address Logic -

Referring to the logic diagram Figure 2, the payload is

addressed by sending the proper four tone pairs in sequence within 3 sec. Using Payload 171 as an example, this would consist of sending the PL, PK, PI and PJ tone pairs conforming to the format as shown in Figure 2. This will sequentially place the address flip-flops, F_1A and B, F_2 A and B, etc. to the zero state. When the address flip-flops have been reset from ones to zeros with the proper sequence within the proper time frame, the payload command system will be addressed and D.L. Command Enabled. If any break in the sequence occurs within the time frame, the false address detect will reset the address register and the payload address must be sent again. When the system is not enabled or reset, the address flip-flips are set to ones, thus at the completion of a payload address sequence, the flip-flops are all zeros.

The 170 Series command decoder has been divided into two separate sections. One that allows commanding of routine D.L. functions and another that allows commanding of housekeeping and control functions. The four tone pair sequence enables only the D.L. command functions. The housekeeping functional commands are enabled by an additional tone pair, i.e., in 171, the pair is PN, that is only accepted when the system is D.L. command enabled (which required the four tone pair sequence). This separation of the D.L. command functions and the housekeeping control functions was done to prevent inadvertent erroneous commanding of control functions. In normal tasking of the payload, the system need never be housekeeping command enabled. The two functions are mutually exclusive, i.e., the D.L. command enable and the housekeeping command enable cannot simultaneously exist.

c. Functional Command Logic -

Referring again to Figure 2, once the payload has been addressed, the system has sent D.L. Command Enabled. All of the matrices that are powered by the D.L. Command Enable line are then active. The matrices are 4-line to 16-line decoders that decode the 16 possible states of the address flip-flops once the system is enabled. The proper matrix is selected by use of a tone pair which when sent will activate the function decoded by the matrix. The states of the address flip-flops are controlled by the address tone pairs (PL, PK, PI and PJ) which set the flip-flops to "zeros" and the address tone pair complements (ML, MK, MI and MJ) which set the flip-flops to "ones." The address-command flip-flops can be set or reset in any order once the system has been enabled. Previous to addressing and enabling the payload, the flip-flops can only be set to zeros in the proper sequence. Any break in the sequence and the entire sequence must be repeated.

The D.L. Command Enable Line, when true, logically enables four matrices; the LK, JL, LI and JK matrices. A command function is selected by setting or reseting the address flip-flops to one of the 16 possible states and then sending the proper tone pair activate, LK, JL, LI, or JK. Additional commands functions are selected by changing the states of the address F-F's and sending the proper activate tone pairs. This operation is the same as previous missions.

d. Execute Mode -

Once all of the desired D.L. command functions have been activated by the proper tone pairs, the Execute tone pair KI is sent. It is the last command sent. It performs two functions; it initiates operation of all D.L. functions that have been commanded "ON", provided that a delayed mode of operation has not been selected by use of the system timer and it locks out the command system so that once KI has been sent no other commands are accepted until the system receives a master reset tone pair, i.e., MQ (P.L. 171) or a master reset from the system timer.

e. Remote Command Multiplexer -

In order to meet the command flexibility required for the options associated with each band, a command multiplexer was added to the D.L. control subsystem. Its purpose is to provide the additional commands needed for each band. This was accomplished by adding a third dimension to the command matrix by the use of a command shift register associated with each D.L. command, and a common "advance" or shift command, tone pair NK, that is used with all D.L. commands. Its operation is best described by referring to Figure 4. Any time a band is turned on, the first stage of the band's command multiplexer register is turned on, or set to a logic "one." If options are desired, an advance tone pair NK is sent followed by the band's activate tone pair, without changing the address register flip-flops (Figure 3); i.e., NK, activate, NK, activate, etc. If certain options are desired and not others, advance tone pairs NK are sent until

the proper option is reached, then the band activate tone pair is given, i.e., NK, NK, NK, activate would give Option #2 of the selected band. The advance tone pair NK merely advances the states of the shift register. Each band in every payload, except Band 17 payload A and B, is treated the same. Band 17 in payload A and B will be treated separately.

Figure 5 shows a three dimensional picture of a typical command sheet. The command multiplexer has added the third dimension to the conventional command sheet. As an example, consider turning on Band DL2 with Option #2. The address register flip-flops in the command decoder are first set to the 0001 state after DL Command Enabling. The LK tone pair activate is then sent. At this time, Band DL2 will be selected. The LK tone pair is followed by three (3) advance tone pairs, NK, NK, NK, and an additional LK activate. This selects Option #2 of Band DL2. During this sequence, the address register states 0001 should not be changed. Again the sequence is address, set command register to the proper state 0001, LK activate, advance NK, NK, NK, and LK activate. Using P.L. 171 as an example; (Address) PL PK PI PJ, (set command register 0001) MJ, activate LK, advance NK, NK, NK, activate LK.

The command multiplexer register Figure 4, is used to advance into the third dimension of the command sheet. It can be used in commanding a Band's options only after the band has been selected by the proper pair. In most tasking situations, no or very few options will be used. This technique minimizes the numbers of commands that must be sent under normal operation.

The actual options and the decision making process used in sending the proper commands will be covered in a later Section by the use of a decision flow chart.

D. L. Programmable Timer -

The D. L. Programmable Timer is designed to provide operation similar to the recycling timer of 7106. The timer provides for delayed execution of all D.L. functions for up to 140 minutes in commandable 10-minute increments. The selected time delay starts with the Execute Command. The system basically consists of two recycling ring-counters, a three-state counter and a five-state counter. Upon enabling the command system, the counters are respectively set to 100 and 10000 states. Commands are then sent to select the desired D.L. Bands that will be turned on when the D.L. system is executed. If the delayed mode is not desired, the Execute Command is sent and a normal 50 minute "ON" cycle will occur. If delayed operation is desired, the ring counters are advanced by the timer Cmd #1 (1111-LK) and time Cmd #2 (1111-JK). The number of times each command is sent relates to the delay that will occur from the time the execute command KI is sent until the entire D.L. system is turned on. Figure 6 show the states of the counters and the time delay that will occur by sending the timer #1 and timer #2 commands prior to executing (KI). The number of commands that were received by the timer are telemetered on IRIG CH 5 Segments 31 and 32, and on the PCM telemetry system Words 2-12 and 2-13. The level telemetered relates directly to the number of commands sent. Example: a two volt level on Segment 31 and Word 2-12

means that the timer #1 command was sent twice and the state of the three-stage ring counter was advanced from 100 to 001. If the timer #2 Cmd was sent three times, Segment 32 and POM Word 2-13 would read 3 volts. If the timer was left in this state and execute (KI) was sent, a 70-minute delay would occur before the D.L. system was turned on. The delayed mode ends when the ring counters are in sync at the 100 and 10000 states. The ring counters are driven by a 10-minute timer.

If the payload is received with the D.L. system executed with the timer on, an approximate estimate can be made as to how much time remains in the delayed mode by monitoring the timer command segments. If a two volt level is received on Segment 31 and one volt level is received on Segment 32, there are approximately 40 minutes remaining before the D.L. system will be turned on (refer to Figure 6). This is also true of the "ON" mode. The time remaining during the "ON" mode can be determined by monitoring Segment 31 and Segment 32 of CH 5.

The timer "ON" time duration is fixed at either 50 minutes or 20 minutes. Normal operation is the 50-minute mode. A 20-minute "ON" time can be obtained instead of 50 minutes by sending (1011 JK) the D.L. timer short cycle command. At the completion of the 20-minute "ON" cycle, the D.L. system will be reset and the timer will be returned to the normal 50-minute mode, meaning the next time the D.L. system is executed the "ON" time will be fifty minutes. Each time a short cycle is desired, the short cycle command must be sent prior to executing (KI) as the system has automatically been returned to the 50-minute mode.

III. COMMAND FUNCTIONS/AVAILABLE MODES

Appendix A, Part I, contains the command sheets for the four payloads of the 170 Mission and the payload command system addresses for each payload. As this discussion is primarily concerned with the operational use of the payload data-link subsystems, only the commands concerning this operation will be discussed. All commands listed in the command sheet and identified by the abbreviated symbol (CMD) following the activate tone pair, i.e., LK(CMD) are Housekeeping control commands and should never be sent without authorization.

All commands identified by the abbreviated symbol (DL) following the activate tone pair, i.e., LK(DL) are D.L. system operation commands. There are four matrices set aside for operational D.L. commands, i.e., LK(DL), JL(DL), LI(DL) and JK(DL). The commands on the LK(DL) and JL(DL) matrices The commands on the LK(DL) and JL(DL) matrices are redundant with the back up command being the logic complement of the primary command, i.e., the command for DL 1 is 0000LK(DL) and the backup command is 1111JL(DL). The other matrices LI(DL) and JK(DL) contain additional D.L. commands.

a. Operational Flexibility -

Many of the Bands in the 7107 Payloads have commandable options such as Horizontal or Vertical polarization, switchable quadrants, etc. In order to cope with the necessary command expansion at a minimum increase in operational effort, the previously discussed command multiplexer was added to all (DL) commands, and works identically the same on all bands.

Referring to the Collection Coverage For Mission 7107, Appendix B, Part I, it can be seen that all Bands have been assigned to a down-link transmitter either B, C, or D, and have a fixed modulator pulse width W, X, Y, or Z. One of the available options in Mission 7107 is the ability to change the transmitter assignment by ground command. If a Band is normally assigned to transmitter B, it can be assigned to either C or D on command. It will maintain its new assignment until the Reset command is sent. The Option #1 and Option #2 commands (Figures 4 and 5) are used to re-assign a Band to a transmitter in the following order: If the normal assignment is Xmtr B, Option #1 command moves the Band to Xmtr C and Option #2 command moves it to Xmtr D. If the normal assignment is Xmtr C, the Option #1 command moves the Band to Xmtr D and the Option #2 command moves the Band to Xmtr B. If the normal assignment is Xmtr D, the Option #1 command moves the Band to Xmtr B and the Option #2 command moves the Band to Xmtr C. Depending on the exact tasking, it may be necessary to re-assign a Band to a different down-link. When a Band is first turned on, it has its normal transmitter assignment.

Other available options are horizontal or vertical polarizations and either port and starboard or fore and aft quadrants. If a Band has the quadrant option or the polarization option, both polarizations are selected when the Band is turned on and all quadrants are selected. If only one polarization is desired or only two quadrants are desired, the command multiplexer must be used to turn off the function that is not desired. Referring again to Figures 4 and 5, the command multiplexer

outputs labeled Aoff and Boff perform these functions. When the [illegible] first turned on, both H and V polarizations are selected. By the use of the command multiplexer and the advance command NK, either the H or V polarization can be selected. Aoff turns the horizontal polarization off leaving the vertical on and Boff turns the vertical off, leaving the horizontal on. The same is likewise true of the port-starboard and fore-aft quadrants. Aoff turns off port-starboard and Boff turns off fore-aft. This only pertains to Bands that have these options.

The final commandable option pertains to the Signal Level Measurement (SLM) and the Adjustable Threshold Option. Figure 7 is a block diagram of the system configuration of these measurement devices. Before a signal level measurement or the adjustable threshold can be used with a Band, that Band has to be routed to SLM or the adjustable threshold by using the Parametric Select command for that Band. This command is available on the command multiplexer (Figures 4 and 5) for each D.L. Band Command. Its sole function is to close the low level video switch (Figure 7) routing the Band's video to the signal level measurement or adjustable threshold subsystems. The SLM or the adjustable threshold must be turned on by a separate command.

The signal level measurement subsystem also has the option of being assigned to a different data down-link. Its normal Xmtr assignment is B. It can be assigned to Xmtrs C or D by the use of the SLM Option #1

and Option #2 commands on the SLM command multiplexer. This operation is identical to the previous discussion on Xmtr reassignment.

The adjustable threshold subsystem also has commandable options. Its purpose is to have a single adjustable threholder that has a modulator pulse width W and can be assigned to any Band in the payload except Band 17 Payloads A and B. It can be used as an engineering tool to recover a Band with a failed modulator, noisy detector, etc. It can also be used as an amplitude sorter and to recover high P.R.F. data if an improper choice of pulse width had been made. The adjustable threshold system has four levels of attenuation that can be selected on ground command. The first level is automatically selected by turning on the system. The 2nd, 3d, and 4th are chosen by using the command multiplexer associated with the adjustable threshold on command. Referring to Figures (5, 5A and 5B), the second level is obtained by using the Level A command, the third level by using the Level B command, and the fourth is obtained by sending both the Level A and B commands, i.e., Level 2 by 0101JK(DL)NKJK, Level 3 by 0101JK(DL)NKNKJK, and Level 4 by 0101JK(DL)NKJKNKJK.

The adjustable threshold subsystem also has the command option of reassigning the down-link. It is identical to SLM in that its normally assigned down-link is B and adjustable threshold/Option #1 places it to C and Option #2 places it to D.

In brief summary, all Bands except 17, A and B, in all payloads can utilize SLM and the adjustable thresholder and all Bands except 17, A and B, can have their down-link reassigned.

b. Band 17 Payload A and B Mission 7107 -

Band 17 Payload A and B is the channelized comb filter subsystem in X Band. It consists of 20 individual bands 20 MC wide starting at 9.2 GHz and going to 9.6 GHz. For commanding ease, the 20 Sections $DL17_1$, $DL17_2$ ===== $DL17_{20}$ have been arranged into four preprogrammed groups, DL17, Group 1; DL17, Group 2; DL17, Group 3, and DL17, Group 4, and are arranged as follows:

1. Group 1 = 17_6 - 17_{14}
2. Group 2 = 17_1 - 17_5 and 17_{15} - 17_{20}
3. Group 3 = 17_4, 17_6, 17_8, 17_{10}, 17_{14}, and 17_{17}
4. Group 4 = 17_2, 17_5, 17_7, 17_9, 17_{11}, 17_{13}, 17_{16}, 17_{18}, and 17_{20}

Each group is turned on as a normal Band would be turned on just by sending the group command. The modulator pulse widths and down-link assigrments are fixed and cannot be changed.

Each of the individual Bands $DL17_1$ - $DL17_{20}$ can be turned on separately, but this must be done in a prescribed manner. Referring to the appropriate 171 and 172 command sheets, there are eight commands that are used in turning the Bands on individually; DL17 Enable, DL17 (1-3), DL17(4-6), DL17(7-9), DL17(10-12), DL17(13-15), DL17(16-18), and DL17(19-20). Figure 5C shows a chart of these commands and their matrix. The technique used here in turning on the individual bands within Band 17 is asfollows: First, the DL17 Enable command must be sent 0010LI(DL) followed by an advance tone pair NK. Then, the individual commands for any Band 17 sub-band that resides in Column #1 of Figure 5C, i.e., 17_1, 17_4, 17_7, 17_{10}, 17_{13}, 17_{16}, or 17_{19}, must be sent. These commands are followed by an advance tone

pair NK that steps us from Column #1 to Column #2. At this point any sub-band command that is desired from Column #2 is sent, i.e., 17_2, 17_5, 17_8, 17_{11}, 17_{14}, 17_{17}, or 17_{20}, this command or commands are followed by one last advance tone pair NK which steps us from Column #2 to Column #3. Then the command functions that are desired from Column #3 are sent. Once again, the wholesequence is DL17 Enable 0010LI; advance NK; any, all or none of the functions of Column #1; advance NK; any, all or none of the functions of Column #2; advance NK; any or all of the functions of Column #3. The DL17 Enable Command enables the command multiplexer for commanding the sub-bands of DL17. The common advance command tone pair NK steps you into Column #1, and from 1 to 2 to 3. (Figure 5C)

c. Other D.L. Functional Commands -

All of the remaining D.L. oriented commands other than Band on SLM on, Adjustable Threshold, etc., are primarily back-up mode commands that would be used only in the event of a system failure.

All of the Elint System is powered from redundant regulators (converters). The D.L. Converter Bypass commands and the D.L. Converter 1 and 2 Select Commands control the states of these regulators. These commands need never be sent unless a failure occurs in the system.

The D.L. MOD OFF commands are of the same nature. If a down-link transmitter should fail, it can be removed from the system by the appropriate D.L. MOD OFF Command. Reconfiguring the D.L. regulators and shutting down a D.L. Xmtr requires an enabling function that is obtained

from the housekeeping control part of the command system. These functions would probably be handled by the Program's domestic ground station.

The Back-up D.L. System "ON" Command is a back-up command to be used only in the event of a failure elsewhere in the system. If the normal Execute KI fails to initiate D.L. system operation, the Back-up D.L. System Command 1001JK(DL) can be used. In this mode, the timer will not function and the normal payload reset, i.e., 171 MQ, will not shut the system off. The only command that will shut the system off is the B-U D.L. system off command, 1000 JK(DL). If the B-U D.L. system on command is ever sent inadvertantly, erroneously received, etc., the B-U D.L. system off command must be sent before normal operation can resume. This is a very important point and the telemetry should be monitored to insure that the system has not unknowingly been placed in this mode.

d. Retep Commands -

The Retep experiment is only available in payloads 173 and 174. Its purpose is for real-time ephemeris calibration. It operates at 809.0 MHz ± .5 MHz and has a tangetial sensitivity of -90 DbM. The Retep on command 1110LI turns Retep on and places it on Xmtr B with a W pulse width. It can be moved to Xmtr C or D by use of the Retep Option #1 and Option #2 commands. Retep can also be commanded to a lower sensitivity by using the low sensitivity command on the Retep command multiplexer. All Retep options are obtained in a similar manner to other Bands by use of command multiplexer.

The Retep receiver can also be used as a transponder for low (200 cps) data rate P.C.M. data by using Retep and the Retep to CH 12 on command 0100JK(DL). In this mode, P.C.M. data is sent in a RZ format to Retep at a 200 cps maximum rate. The data is received and transponded by use of a 2.5 ms wide pulse multi that is switched on to CH 12 in lieu of the normal housekeeping P.C.M. telemetry data. The transponder link is up through the Retep receiver and down on the CH 12 subcarrier of the 137 mc telemetry link. Both Retep and the Retep to CH 12 link must be turned on. When operating in this mode, there will be no normal real-time telemetry.

IV OPERATIONAL USE/COMMAND PREPARATION

The previous Sections were designed to provide an insight into the logic changes made in the 7107 D.L. Command System, and to provide a better overall view of how the system logic works.

As in previous Missions, the system remains basically the same from a "Black Box" view point. Commanding is still done by using the punched IBM Card and the function generator, sending multiple tone pairs in a digital format (Figure 2). The basic system has remained as follows:

a. Payload Address - Requires four sequential tone pairs within a 3 sec. window.

b. Command Register Address - Requires up to four tone pairs to select the proper functional D.L. Command.

c. Matrix Activate - Requires one of four tone pairs to select the proper D.L. Band to be activated.

d. Matrix Advance - Requires one tone pair NK used in conjunction with a matrix activate to select options of a particular band.

e. Execute - Requires the KI tone pair to initiate D.L. system operation.

f. Reset - Requires the MX (X = P, Q, R, or S) tone pair to clear system and terminate D.L. system operation.

Major changes in the command operation and preparation are primarily concerned with commanding the numerous options that are available in 7107. Before going into the sequence of events that must transpire in commanding

options, the basic system will be repeated as the options are an extension of this.

In the basic system, the payload address is unique to each payload. It consists of four different tone pairs which must be sent in the proper sequence to effect an address. An address must be accomplished before any functional command can be performed. Once addressed, the P.L. is said to be D.L. Command System Enabled, and a D.L. functional command will be accepted until the system is either Reset or Executed.

The matrix command register is best understood if it is approached from a digital standpoint. Consider the command system as being in the 0000 state when enabled. From this point, there are fifteen other unique states; i.e., 0001, 0010, 0011, ------ 1111. The sixteen different states that the matrix command register can be placed into, together with the four D.L. Activate tone pairs, gives a total of 64 primary D.L. commands. In certain instances, some of these commands have a command multiplexer that extends their effective use by five. The command multiplexer is used in conjunction with a normal D.L. command and will cause up to five additional functions to occur from the one command.

Once a payload has been addressed, the matrix command register can be placed in any state by sending any address tone (i.e., 171 PL, PJ, PK, PI) which sets the desired register position to a "ZERO" or by sending the address complement, i.e., (in 171 ML, MI, MK, MJ) which will set the desired register position to a "one." The states listed on the command sheets, (i.e., 0000, 0001, etc.) refer to the states of the four address register

Flip-Flops. The first address tone pair, i.e., (171 - ML) controlling the one state. The second address tone pair, i.e., (171 - PI) controls the state of the second Flip-Flop, etc. The complement of any address tone pair or Flip-Flop is the address tone pair with the M tone substituted for the P, Q, R, or S, (171, 172, 173 and 174). As mentioned above, the four components of the digital Word correlate directly with the four address tones. Assume an address of PL, PI, PK, PJ. Sending these tone pairs in this sequence established the 0000 condition and D.L. Command Enables the system. To set the matrix command register to the 0010 condition would require sending the complement of the third tone pair MK. As it is not desired to change the remaining three 0's to 1's for this command, no other commands should be sent. The matrix command address has been set at this point and it will remain in this condition until purposely altered by an additional command.

Having enabled the command system and set the matrix to a certain code, in this case 0010, additional commands may be sent by complementing the desired matrix bit or position in the matrix. A P, Q, R or S, depending on the payload, together with the proper address tone will complement a "one" to a "zero." An M tone, together with the proper address tone, will complement a "zero" to a "one." The previous example left the matrix with a 0010 selected, with the command system still enabled. In order to change the matrix to 0001, a PK and a MJ must be sent. the PK complements the third position to a zero and the MJ sets the last position to a "one."

Once the command system has been enabled, the command matrix may be placed in any position without regards to sequence; i.e., the first position may be set to a one or zero and the last may be set to a one or zero without regard to the position of address two and three.

Having successfully accomplished an address in the matrix, a command function may be accomplished by sending a Matrix Activate. The activate command is necessary as the PL actually contains four separate matrices, all of which are addressed simultaneously. Each matrix has its own independent, activate tone pair. Thus, four command functions may be obtained from a single matrix address, (by sending the four activate commands). The activate commands are JL, KL, LI and JK.

Summarizing what has been discussed to this point:

a. Starting from the reset condition, the DL is first addressed to obtain the Enable condition.

b. A matrix activate is sent next to perform the command function. As four different matrices are addressed simultaneously, the proper matrix for a given function must be selected by the activate command.

d. Having performed a command at this point, the matrix address may be changed and a second activate command sent (or the same one) to perform a second command function. This procedure is repeated until the desired number of command functions have been performed.

e. The EXECUTE Command is the last command sent. It performs two functions:

(1) It initiates operation of all the DL functions that have been commanded "ON," provided that a delayed mode of operation has not been selected by use of the system timer.

(2) It locks out the command system so that once KI has been sent, no other commands may be sent. This is true under normal system operations.

As mentioned previously, the major changes in the command system are the addition of a command multiplexer to certain D.L. function commands. The command multiplexer's function is to provide multiple commands from one D.L. function command. This is accomplished by repeating the activate tone pair. Before the activate tone pair is repeated, one or more advance or repeat tone pairs NK are sent. This signals the multiplexer to accept the additional tone pair activates. Once again, a functional D.L. command is set up in the matrix register (as in previous Missions), i.e., 0001LK, and the activate LK is given. If some of the available options for this command are desired, the advance tone pair NK is given (up to five times depending on the option). The option is selected or commanded by repeating the activate LK, in this case, after the proper number of advances. If an option is not desired, it is merely by-passed by the advance tone pair. Figures 4, 5, 5A and 5B should be referred to. When the matrix command register is set to a particular command and the activate is sent, a Band

is selected to come on. At this time, the Band's command multiplexer is enabled and with the matrix still set, the activate is repeated following the advance tone pairs NK. Once the matrix has been changed, it is impossible to get a Band's options. It is a sequencial operation, that cannot be broken. You must keep the address matrix set to the proper band when dealing with that band's options. The sequence for each band's options is: Set the matrix for the desired band, activate; obtain options by advances and additional activates; and change matrix for new or different band.

Commanding is identical to previous Missions with the exception of the options. A command multiplexer is associated with the following commands:

SLM 0110JK(DL), All Payloads

Adj. Thresh. 0101 JK(DL), All payloads

Retep 1101LI(DL), PL 173 - 174

All DL Commands DL1 - DL21, PL 173 - 174

All DL Commands DL1 - DL16, PL 171 - 172

The actual options that are obtained, when using the Advance NK and repeat activate technique, are listed in Figures 5A and 5B.

In order to help understand the process that one must go through in preparing the command card, decision making flow charts have been made, (Section IV, Figures 1, 2, 3, and 4). The chart "walks" you through the decisions that must be made when preparing to send a command, in particular the options of a command.

Referring to Figure 1, Section IV, the first operation is to reset the payload, next send payload address, then set up command matrix address,

and activate. At this point we come to a decision block, where the question is asked, "Is this a special D.L. command?" By definition, the SLM, Adjustable Threshold DL17 Enable, and Retep on are the only special D.L. commands, all other D.L. functions commands are considered normal. The reason for this question is to route you to a different command setup subroutine. If the command you are sending was DL2 on, you would be routed to the decision block"Parametric Select?" By answering yes that you want Parametric Select on this Band, you are told to Advance (NK) and Activate (LK for DL2). By following thru the Flow Chart, you are routed out to the final decision block "Last Command?" If this was the last command, you would Execute KI and command system Reset MN. This puts the D.L. system in operation and resets the command Register to all one's, and not enabled. In order to more vividly demonstrate how the Flow Chart is used, consider the simple example of turning DL3 on in P.L. 171 with Option #1 selected, and Execute. The example is shown in the attached chart. The event or decision required by the flown chart is listed and the required tone pairs are listed to the right. Sample #1 was prepared by going thru the Flow Chart, answering the decision blocks and taking the appropriate action. A list of sample tasks will be given to demonstrate using the Flow Charts.

Sample 2 -

It is required that P.L. 173 be tasked with Band 6, Fore/Aft, and routed to SLM. From the collection coverage chart, we see that Band 6 is normally on Xmtr B. SLM is also normally on Xmtr B; therefore, one or the other must be moved to an alternate Xmtr via the Band 6 Opt #1 command to

move Band 6 to Xmtr C or use the SLM Option 1 command to move SLM to xmtr C. If one or the other is not moved, then both will be on xmtr B and the normal pulse width will be obscured by SLM. We will place SLM to xmtr C by using the SLM Opt #1 command. The Band must be turned on, routed to SLM, and port starboard turned off as we only want Fore Aft. SLM must be turned on and its Option #1 command must be sent. Then the system is executed.

Sample #3

It is required that P.L. 172 be tasked with Bands 17-7, 17-6 and Band 11, & SLM. From the collection coverage chart we can see that 17-7 is a C/Y (A Y pulse on xmtr C) and 17-6 is a B/Y. Also, Band 11 is on xmtr C with a Z pulse width. The only xmtr available for SLM is xmtr D; therefore, SLM must be reassigned to xmtr D by use of the SLM command multiplexer. All xmtr assignments for 171 & 172 Band 17 are fixed and cannot be changed. The individual sub-bands of Band 17 are turned on by using the Band 17 Enable Command and the seven commands provided for the sub groups of Band 17. Band 11 must be turned on and routed to SLM by using the parametric select command (Figures 4 and 5). SLM must be turned on and the SLM Opt #2 command must be sent to place the SLM output onto xmtr D. The system is then executed. The Sample #3 command sheet shows the sequence of tone pairs that would be sent to accomplish this task making use of the command setup decision flow charts for SLM, Band 17, etc. Remember Band 17 Payloads 171 and 172, and SLM are considered as special D.L. Commands on the Decision Flow Charts. They are considered separately in order to use the special command setup subroutines.

With the first three (3) sample programs, the D.L. System would have come on immediately with the Execute tone pair KI and would have remained on for approximately 50 minutes unless turned off by the payload reset command. This is the normal 50 minute on time for the D.L. Timer. If a delayed mode of operation were desired, the timer Cmd #1 (1111-LI) and/or the timer Cmd #2 (1111-JK) would have been used to give the desired delay time that would have occurred between Execute (KI) and the D.L. System coming on. Referring to Figure 6, if a delay of 70 minutes were required after executing and before the D.L. System actually came on, it would be necessary to send the time Cmd #1 twice and the timer Cmd #2 three times. These two commands were purposely assigned the same command register address (i.e., 1111) differing only by the activate tone pairs LI and JK. Thus, in sending the commands once, twice, etc., we need only repeat the activate tone pairs and not change the command register address from all 'ones' when going from Cmd #1 to Cmd #2. These commands are only used when delayed operation is desired. If the commands are used, the D.L. System does not come on with Execute, but must wait for the delayed operation of the timer prior to coming on. When the System does come on, it will remain on for 50 minutes unless it has been commanded for a short cycle or 20 minute operation.

Sample No. 4 gives an example of the delayed operation. It is desired to have a delayed operation of 70 minutes with an on-time of twenty minutes in lieu of 50 minutes on Payload 171. The task also requires Band 7 vertical

only and Band 5 horizontal only. The payload must be addressed and placed into the delayed operation via the timer Cmd #1 and Cmd #2. As Band 7 requires only the vertical polarization, the D.L. 7 Aoff command must be sent using the D.L. 7 command multiplexer to turn off the Band 7 horizontal polarization. Band 5 requires horizontal only, therefore, the Band 5 Boff command must be set to turn off the vertical polarization. As the on time required is 20 minutes, the timer 20-minute command 1011JK(DL) must also be sent. Once this is accomplished, the system can be executed (KI).

The order in which the commands are sent once the system is Enabled is not important except when using a particular command's command multiplexer or when using the timer Cmd #1 or Cmd #2. For example, it does not matter in Sample #4 whether the 20-minute time command is sent first or last or, whether DL5 is turned on before or after DL7. The objective, when preparing a command sheet, is to minimize the number of tone pairs sent by placing the commands in order, so that the minimum number of changes is made in the address register; i.e., suppose we wanted DL12(1010), DL14(1000) and DL15(1011). By sending them in the following order: DL14(1000), DL12(1010), and DL15(1011), we merely have to add a one each time, then activate. By carefully selecting these sequences, it is possible to minimize the overall commanding sequence.

Appendix A

COMMAND TONE ALPHABET

I	3.95 KC
J	4.50
K	5.25
L	6.00
M	6.75
N	7.50
P	8.20
Q	8.80
R	9.40
S	10.00
T	10.70
U	11.60

170 SERIES COMMAND SYSTEM TONE PAIRS

PAYLOAD	171	172	173	174
ADDRESS	PL, PI, PK, PJ	QK, QL, QI, QJ	RJ, RK, RI, RL	SL, SJ, SI, SK
Address Complement	ML, MI, MK, MJ	MK, ML, MI, MJ	MJ, MK, MI, ML	ML, MJ, MI, MK
Command Enable	PN	QN	RN	SN
Execute	KI	KI	KI	KI
DL Reset	MQ	MP	MS	MR
Advance	NK	NK	NK	NK
Backup Enable	NJ	NJ	NJ	NJ
Command Reset	MN	MN	MN	MN

TONE PAIR →	MTX BOX 1 JK(CMD)	MTX BOX 2 LI(CMD)	MTX BOX 1 JL(CMD)	MTX BOX 2 LK(CMD)	MTX BOX 2 NI(CMD)
0000	HK SENS ON	ALT ORD ENAB OFF	HI THRUST *	REC AUDIO TO TM XMTR OFF	ANALOG TM ON
0001	HK SENS OFF	BOOM MOTOR IN #	LO THRUST *	RW FWD * #	ANALOG TM OFF
0011	BATT BYP ON *	BOOM MOTOR ON * # GG BOOM REL * #	TH. MAN. CYCLE *	RW OFF * #	PCM DATA SEL ON
0010	BATT BYP OFF	TM MOD ANALOG	TH. 1 ON; HEAT 1 ON *	RW REV * #	PCM DATA SEL OFF
0110	BATT BYP ENAB ON *	TM MOD DIGITAL	TH. 2 ON; HEAT 2 ON *	CH/VOLT CON ON	PCM TO DL ON
0111	BATT BYP ENAB OFF*	UNDER VOLTAGE OFF *	THRUSTERS OFF *	CH/VOLT CON OFF *	PCM TO DL OFF
0101	TM XMTR ON	BOOM MOTOR OUT #	TH. HEATERS OFF *	CH CON HI SEL *	PCM BIT RATE FAST
0100	TM XMTR OFF	ALT ORD ENAB ON	RW ON *	CH CON LO SEL *	SUB-FRAME 1 SELECT
1100	BOOM MOTOR ON * GG BOOM REL *	BATT BYP ON * #	RW OFF *	MEMORY ON	SUB-FRAME 2 SELECT
1101	BOOM MOTOR OFF	BATT BYP OFF #	RW REV *	MEMORY OFF	SUB-FRAME 3 SELECT
1110	BOOM MOTOR IN	PRIM + BATT SEL *	RW FWD *	REC.AUDIO TO TM XMTR ON *	SUB-FRAME RESET
1010	BOOM MOTOR OUT	TM XMTR ON #	RW PRIM PA *	TH.HEATERS OFF * #	MEMORY READOUT #
1001	ANT RELEASE BU *	SEC + BATT SEL *	RW SEC PA *	PCM TIMER RESET	PCM BIT RATE SLOW
1000	UNDERVOLTAGE ON *	PRIM-BATT SEL *	RW PRIM CON *	THRUSTERS OFF * #	RESET TIMER ON
1011	ORD ENABLE ON	SEC-BATT SEL *	RW SEC CON *	RW ON * #	RESET TIMER OFF
1111	ORD ENABLE OFF	HK SENS ON #	RW SPEED MON ON	RW SPEED MON OFF	PCM TM ON #

* - ORDNANCE ENABLE
\# - BACKUP CMD

TONE PAIR →	MTX BOX 1 LK(DL)	MTX BOX 2 JL(DL)	MTX BOX 1 LI(DL)	MTX BOX 2 JK(DL)	MTX BOX 1 JI(CMD)
0000	DL1	DL16 #		DL CONV ON	PCM TM ON PCM POWER A
0001	DL2	DL11 #		DL CONV BYP * #	PCM TM OFF
0011	DL3	DL9 #	DL CONV BYP *	DL CONV 1 SEL	PCM OSC A
0010	DL4	DL10 #	DL17 ENABLE	DL CONV 2 SEL	PCM OSC B
0110	DL5	DL13 #	DL17 GRP 1	SLM ON	PCM A-D A
0111	DL6	DL14 #	DL17 GRP 2		PCM A-D B
0101	DL7	DL12 #	DL17 GRP 3	ADJ.THRESH.ON	MEMORY READ OUT
0100	DL8	DL15 #	DL17 GRP 4		PCM POWER B
1100	DL9	DL3 #	DL17 (1-3)	DL MOD 1 OFF *	PCM MTPLX A
1101	DL10	DL4 #	DL17 (4-6)	DL MOD 2 OFF *	PCM MTPLX B
1110	DL11	DL2 #	DL17 (7-9)	DL MOD 3 OFF *	PCM TIMING CHAIN A
1010	DL12	DL7 #	DL17 (10-12)	DL MODS ON *	PCM TIMING CHAIN B
1001	DL13	DL5 #	DL17 (13-15)	BU DL SYS ON	MEM A 1 SAMP
1000	DL14	DL6 #	DL17 (16-18)	BU DL SYS OFF	MEM AO SAMP
1011	DL15	DL8 #	DL17 (19-20)	20 MIN TIMER	MEM B1 SAMP
1111	DL16	DL1 #	TIMER CMD 1	TIMER CMD 2	MEM BO SAMP

* - ORDNANCE ENABLE

\# - BACK UP CMD

EXP NO. 173-174 — refer to 174 only COMMANDS 10/15/71

TONE PAIR →	MTX BOX 1 LK(DL)	MTX BOX 2 JL(DL)	MTX BOX 1 LI(DL)	MTX BOX 2 JK(DL)	MTX BOX 1 JI(CMD)
0000	DL1	DL16 #		DL CONV ON	PCM TM ON PCM POWER A
0001	DL2	DL11 #		DL CONV BYP # *	PCM TM OFF
0011	~~DL3~~	~~DL9~~ #		~~DL CONV 1 SEL~~	~~PCM OSC A~~
0010	~~DL4~~	~~DL10~~ #	~~DL CONV BYP~~ *	~~DL CONV 2 SEL~~	~~PCM OSC B~~
0110	~~DL5~~	~~DL13~~ #	~~DL 17~~	~~SLM ON~~	~~PCM A D A~~
0111	~~DL6~~	~~DL14~~ #	~~DL 18~~		~~PCM A D B~~
0101	DL7	DL12 #	DL 19	ADJ.THRESH.ON	MEMORY READ OUT
0100	DL8	DL15 #	DL 20	RETEP TO CH 12 ON	PCM POWER B
1100	DL9	DL3 #	DL 21	DL MOD 1 OFF *	PCM MTPLX A
1101	DL10	DL4 #	RETEP ON	DL MOD 2 OFF *	PCM MTPLX B
1110	~~DL11~~	~~DL2~~ 6 (174) #		~~DL MOD 3 OFF~~ *	~~PCM TIMING CHAIN A~~
1010	~~DL12~~	~~DL7~~ #		~~DL MODS ON~~ *	~~PCM TIMING CHAIN B~~
1001	DL13	DL5 #		BU DL SYS ON	MEM A1 SAMP
1000	DL14	DL6 2 (174) #		BU DL SYS OFF	MEM A0 SAMP
1011	~~DL15~~	~~DL8~~ #		~~20 MIN TIMER~~	~~MEM B1 SAMP~~
1111	~~DL16~~	~~DL1~~ #	~~TIMER CMD 1~~	TIMER CMD 2	~~MEM B0 SAMP~~

* - ORDNANCE ENABLE

\# - BACK UP CMD

Appendix A - Part I

SAMPLE #1

P.L. 171 DL3 on Option #1 selected and execute

SAMPLE #2

P.L. 173 DL6 on with fore and aft only and parametric measurement selected to SLM. SLM on and its Option #1 command sent. Then execute system.

SAMPLE #3

P.L. 172 Bands 17-7, 17-6 and DL11 on. DL11 is routed to SLM through the DL11 parametric select command. SLM is turned on and its Option #2 command sent, and execute.

SAMPLE #4

P.L. 171 DL7 on vertical polarization, DL5 on horizontal polarization; DL time set for 70 min delay with a 20 minute on time and execute.

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SAMPLE #1

(Refer to Section IV, Figures 1, 2, & 3)

	SEQUENCE OF EVENTS or DECISIONS	ANSWER	ACTION TONE PAIRS SENT
1.	CLEAR ADDRESS (RESET)		MQ
2.	SET ADDRESS		PL, PI, PK, PJ
3.	MODIFY ADDRESS FOR DL3 (0001)		MK, MJ
4.	ACTIVATE FOR DL3		LK
5.	SPECIAL DL COMMAND?	YES	
6.	R&D	NO	
7.	OPT 1?	YES	
8.	2 ADVANCES, ACTIVATE		NK, NK, LK
9.	Aoff?	NO	
10.	Boff?	NO	
11.	LAST COMMAND	YES	
12.	SEND EXECUTE		KI
13.	COMMAND RESET		MN

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SAMPLE #2

(Refer to Section IV, Figures 1, 2, & 3)

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	SEQUENCE of EVENTS or DECISIONS	ANSWER	ACTION TONE PAIRS SENT	COMMENTS
1	CLEAR ADDRESS (RESET)		MS	
2	SEND ADDRESS		RJ, RK, RI, RL	
3	MODIFY ADDRESS FOR DL6(0111)		MK, MI, ML	
4	SEND ACTIVATE FOR DL6		LK	DL6 ON
5	SPECIAL DL COMMAND ?	NO		
6	PARAMETRIC MEASUREMENT SELECT ?	YES		
7	ADVANCE & ACTIVATE DL6		NK, LK	DL6 ROUTED TO SLM
8	OPT 1?	NO		
9	OPT 2?	NO		
10	Aoff?	YES		
11	3 ADVANCES & DL6 ACTIVATE		NK, NK, NK, LK	DL6 PORT/STARB OFF or FORE/AFT ON
12	LAST COMMAND?	NO		
13	MODIFY ADDRESS FOR SLM(0110)		RL	ADDRESS WAS (0111) RL SETS IT TO (0110)
14	ACTIVATE SLM		JK	SLM ON
15	SPECIAL DL CMD?	YES		
16	GO TO (1)			
17	SLM?	YES		
18	OPT 1?	YES		
19	ADVANCE & SLM ACTIVATE		NK, JK	SLM OPT 1 ON
20	GO TO (3)			
21	LAST COMMAND?	YES		
22	EXECUTE		KI	
23	MN RESET		MN	

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SAMPLE #3 (Refer to Section IV, Figures 1, 2, & 3)

	SEQUENCE OF EVENTS or DECISIONS	ANSWER	ACTION TONE PAIRS SENT	COMMENTS
1	CLEAR ADDRESS (RESET)		MP	
2	SET ADDRESS		QK, QL, QI, QJ	
3	MODIFY ADDRESS FOR SLM ON 0110-JK		ML, MI	
4	ACTIVATE FOR SLM		JK	SLM ON
5	SPECIAL DL COMMAND?	YES		
6	GO TO (1)			
7	SLM?	YES		
8	OPT 1?	NO		
9	OPT 2?	YES		
10	2 ADVANCE COMMANDS and SLM ACTIVATE		NK, NK, JK	SLM OPT 2 COMES ON
11	GO TO (3)			
12	LAST COMMAND?	NO		
13	MODIFY ADDRESS for DL11 (1110)		MK	ADDRESS WAS 0110 MK SETS IT TO 1110
14	ACTIVATE FOR DL11		LK	TURNS ON DL 11
15	DL SPECIAL CMD?	NO		
16	PARAMETRIC MEASUREMENT?	YES		
17	ADVANCE & DL11 ACTIVATE		NK, LK	CLOSES VIDEO SW. SHOWN IN FIG 7
18	OPT 1?	NO		
19	OPT 2?	NO		
20	Aoff?	NO		
21	Boff?	NO		
22	LAST COMMAND?	NO		
23	MODIFY ADDRESS for DL17 ENABLE (0010)		QK, QL	ADDRESS WAS 1110 QK, QL SETS IT TO 0010
24	ACTIVATE FOR DL17 ENABLE		LI	DL17 ENABLE ON

SAMPLE #3(Con't) (Refer to Section IV, Figures 1, 3, & 3)

	SEQUENCE of EVENTS or DECISIONS	ANSWER	ACTION TONE PAIRS SENT	COMMENTS
25	SPECIAL DL CMD?	YES		
26	GO TO (1)			
27	SLM?	NO		
28	ADJ THRESHOLD	NO		
29	GO TO (2)			
30	DL17 ENABLE?	YES		
31	ADVANCE		NK	ENABLES CMDS IN FIRST COL
32	ANY COLUMN #1 COMMANDS	YES		
33	MOFIFY ADDRESS for 17_7 (1110)		MK, ML	ADDRESS WAS 0010 MK, ML SETS IT TO 1110
34	ACTIVATE FOR 17_7		LI	$DL17_7$ COME ON
35	LAST COLUMN #1 COMMAND	YES		
36	ANY COLUMN #2 COMMAND	NO		
37	ANY COLUMN #3 COMMAND?	YES		
38	2 ADVANCES		NK, NK	ENABLES CMDS IN COL 3
39	MODIFY ADDRESS for $DL17_6$ (1101)		QI, MJ	ADDRESS WAS 1110 MJ, QI SETS IT TO 1101
40	ACTIVATE FOR $DL17_6$		LI	$DL17_6$ COMES ON
41	LAST COLUMN 3 CMD?	YES		
42	GO TO (3)			
43	LAST COMMAND	YES		
44	SEND EXECUTE		KI	TURNS ON DL SYSTEM
45	SEND MN		MN	RESETS COMMAND REGISTER ONLY

DL 11 will be on C/Z
DL 11 (SLM) will be on D (because SLM OPT was selected)
DL 17-6 will be on B/Y
DL 17-7 will be on C/Y

SAMPLE #4

(Refer to Section IV, Figures 1, 2, & 3)

	SEQUENCE of EVENTS or DECISIONS	ANSWER	ACTION TONE PAIRS SENT	COMMENTS
1	CLEAR ADDRESS (RESET)		MQ	
2	SEND ADDRESS		PL, PI, PK, PJ	
3	MODIFY ADDRESS FOR DL7(0101)		MI, MJ	
4	ACTIVATE DL7		LK	DL7 ON
5	SPECIAL DL COMMAND?	NO		
6	PARAMETRIC MEASUREMENT SELECT	NO		
7	OPT 1?	NO		
8	OPT 2?	NO		
9	Aoff	YES		
10	4 ADVANCES & DL7 ACTIVATE		NK, NK, NK, NK, LK	DL7 Aoff or DL7 VERTICAL POLARIZATION ON
11	LAST COMMAND?	NO		
12	MODIFY ADDRESS FOR DL5(0110)		MK, PJ	ADDRESS WAS (0101) MK, PJ SETS IT TO (0110)
13	ACTIVATE DL5		LK	
14	SPECIAL DL COMMAND?	NO		DL5 ON
15	PARAMETRIC MEASUREMENT SELECT			
16	OPT 1?	NO		
17	OPT 2?	NO		
18	Aoff	NO		
19	Boff	YES		
20	5 ADVANCES & DL5 ACTIVATE		NK,NK,NK,NK,NK,LK	DL5 Boff or DL5 HORIZONTAL POLARIZATION ON
21	LAST COMMAND?	NO		
22	MODIFY ADDRESS FOR DL TIMER (1111)		ML, MJ	ADDRESS WAS 0110 ML,MJ SETS IT TO (1111)

SAMPLE #4 (Cont)

(Refer to Section IV, Figures 1, 2, & 3)

	SEQUENCE of EVENTS or DECISIONS	ANSWER	ACTION TONE PAIRS SENT	COMMENTS
23	ACTIVATE TWICE TIMER CMD #1		LI, LI	DL TIMER SET for 70 MIN DELAY
24	ACTIVATE (3) TIMES TIMER CMD #2		JK, JK, JK	
25	SPECIAL DL COMMAND?	NO		
26	PARAMETRIC SELECT?	NO		
27	OPT 1?	NO		
28	OPT 2?	NO		
29	Aoff?	NO		
30	Boff?	NO		
31	LAST COMMAND?	NO		
32	MODIFY ADDRESS FOR TIMER 20 MIN (1011)		PI	ADDRESS WAS (1111) PI SETS IT TO (1011)
33	ACTIVATE FOR 20 TIMER		JK	DL TIMER SET FOR 20 MIN ON TIME
34	SPECIAL DL COMD?	NO		
35	PARAMETRIC SELECT?	NO		
36	OPT 1?	NO		
37	OPT 2?	NO		
38	Aoff?	NO		
39	Boff?	NO		
40	LAST COMMAND	YES		
41	EXECUTE	1	KI	
42	MN RESET		MN	RESETS COMMAND REGISTER ONLY

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Appendix B - Part II

COLLECTION COVERAGE FOR MISSION 7107

BAND 17 A&B CHANNELIZED 9.2-9.6MC

BAND	XMTR/PW
17-1	B/X
17-2	C/X
17-3	D/X
17-4	B/W
17-5	C/W
17-6	B/Y
17-7	C/Y
17-8	D/Y
17-9	B/W
17-10	C/W
17-11	D/W
17-12	C/X
17-13	B/X
17-14	D/Y
17-15	D/W
17-16	B/Y
17-17	C/Y
17-18	D/Z
17-19	B/Z
17-20	C/Z

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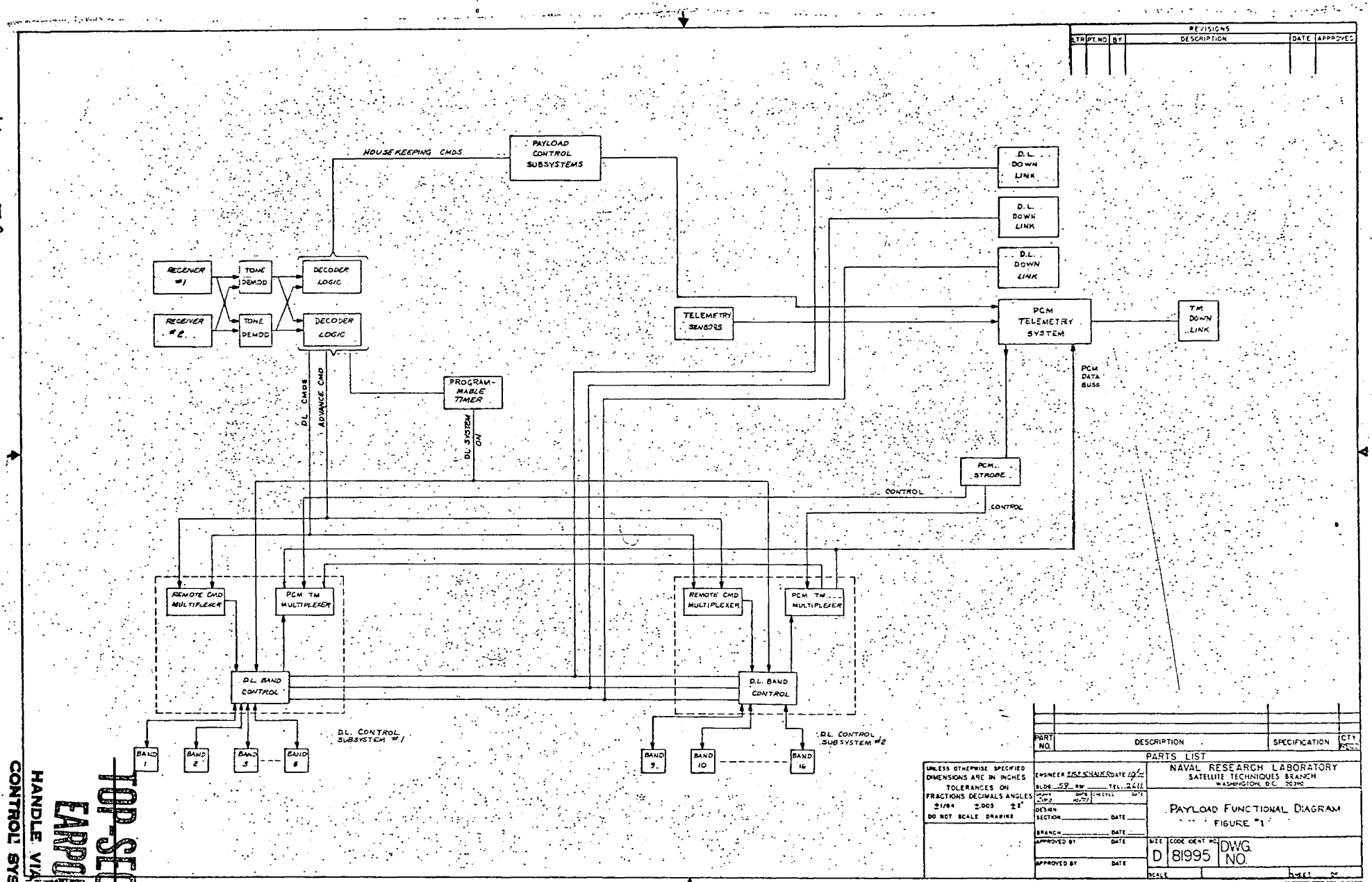
COLLECTION COVERAGE FOR MISSION 7107 (1 September 1971)

Band	Option	XMTR/PW	7107 A&B	Band	Option	XMTR/PW	7107 C&D
1	*	B/W	154-165 MHz	1	*	C/Z	200 - 350 MHz
2	*	B/X	165 - 200	2	*	B/Z	350 - 450
3	*	B/Z	550 - 815	3	*	C/Y	450 - 550
4	* A/B	D/W	815 - 970	4	*	D/X	815 - 970
5	Pol H/V	B/X	1800 - 2100	5	Quadrant	D/Z	970 - 1205
6	Pol H/V	C/X	2100 - 2580	6	Quadrant	B/Y	1205 - 1800
7	Pol H/V	C/Y	2580 - 2680	7	Quadrant	C/X	2100 - 2580
8	Pol H/V	D/Y	2680 - 2930	8	Quadrant	D/Y	2680 - 2930
9	Pol H/V	D/X	2930 - 3120	9	Quadrant	C/X	4850 - 5250
10	Pol H/V	B/Y	3120 - 3300	10	**	B/X	6400 - 6725
11	Pol H/V	C/Z	3300 - 3600	11	Quadrant	D/X	6700 - 7900
12	*	D/Z	3600 - 4050	12	Quadrant	C/X	7900 - 8600
13	Quadrant	C/Y	4050 - 4850	13	Quadrant	B/W	8600 - 9100
14	Quadrant	D/W	5250 - 5850	14	Quadrant	C/W	9100 - 9340
15	Quadrant	B/W	5850 - 6725	15	Quadrant	D/W	9340 - 9400
16	**	C/W	A 17.0-18.0 GHz B 12.5 - 14.5	16	Quadrant	C/Y	9400 - 9600
				17	Quadrant	D/Z	9600 - 10500
17	Channelized** ≠ Fore/Aft =A Port/Starb =B		9.2 - 9.6	18	**	B/W	14.5 - 14.8 GHz
				19	**	C/W	14.8 - 15.1
				20	**	D/W	C 15.0 - 16.0 D 16.0 - 17.0
				21	**	B/W	34.7 - 35.0

* omni-directional coverage ** sectoral coverage

≠ See attached page for detailed information.

TOP SECRET



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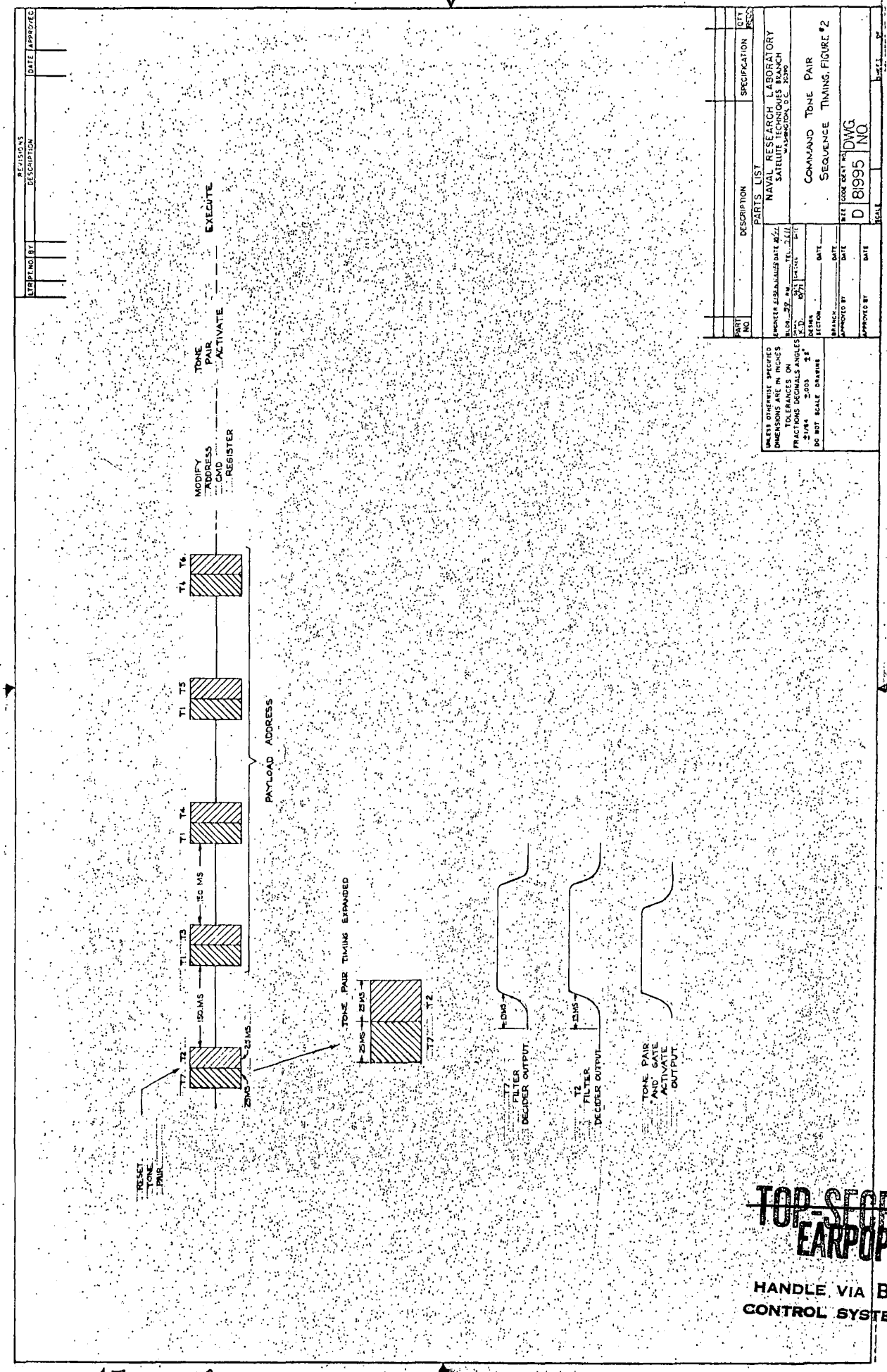
EARP/P
HANDLE VIA BYEMAN
CONTROL SYSTEM ONLY



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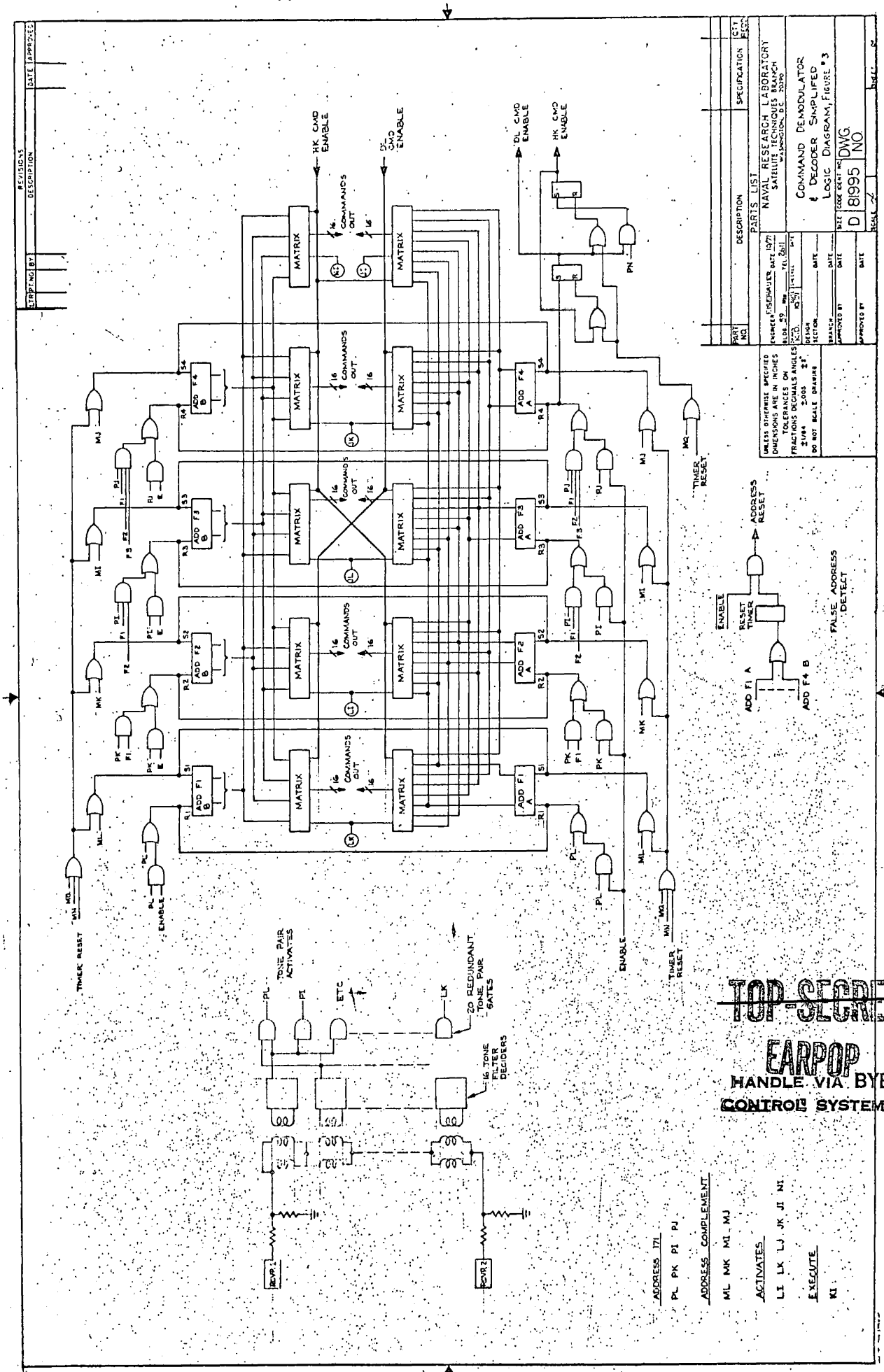

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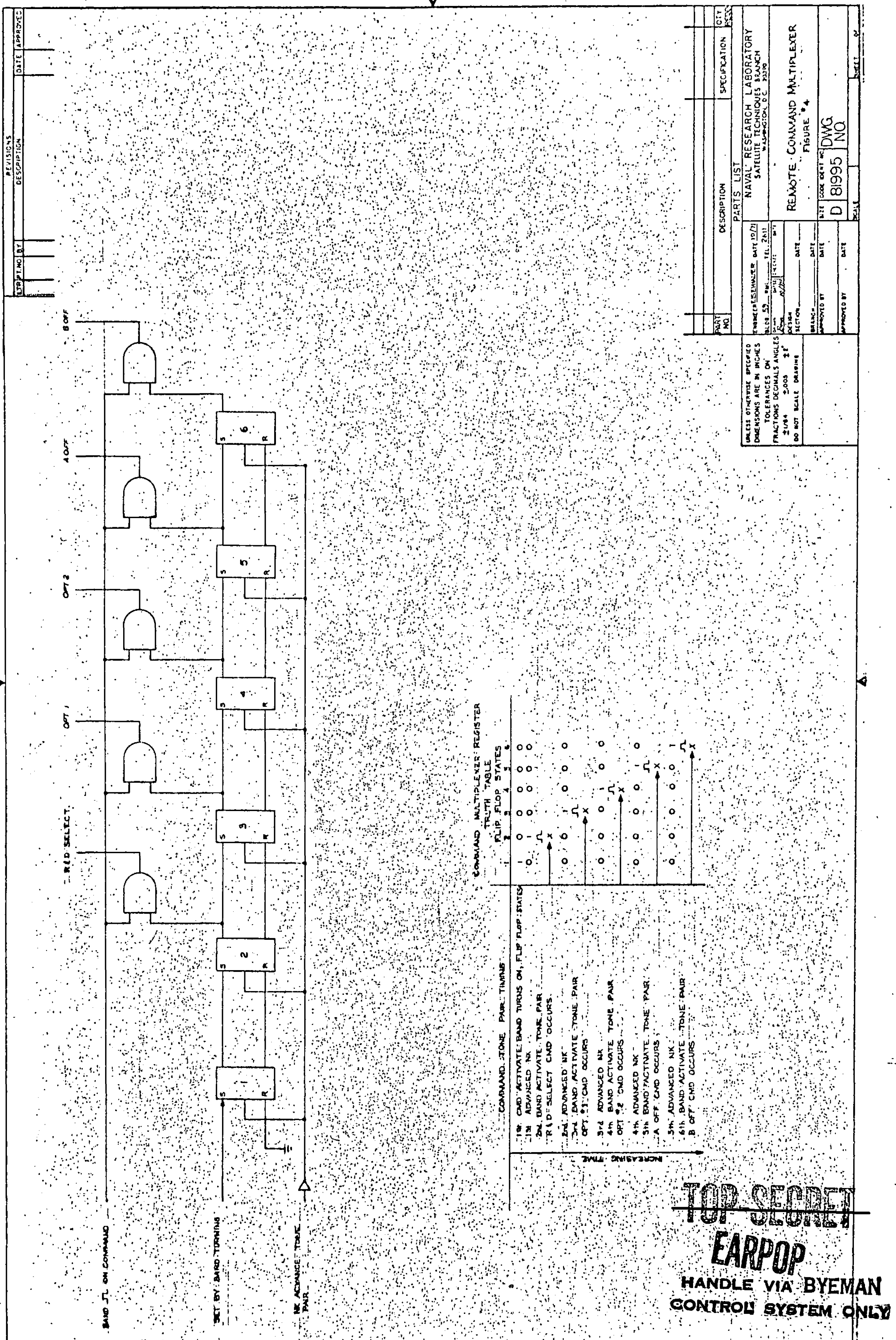

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PAYLOAD 171 & 172 D.L. COMMAND OPTIONS

Address Register States	Tone Pair Activate	Advance Tone Pair	Parametric Select		*Opt 1		Opt 2		Aoff		Boff
	LK	NK	LK	NK	LK	NK	LK	NK	LK	NK	LK
Primary Cmds. F_1 F_2 F_3 F_4	Primary Cmds.										
0 0 0 0	DL1		DL1						NONE		NONE
0 0 0 1	DL2		DL2						"		"
0 0 1 1	DL3		DL3						"		"
0 0 1 0	DL4		DL4						"		"
0 1 1 0	DL5		DL5						Horiz Pol		Vertical Pol
0 1 1 1	DL6		DL6						" off	"	" off "
0 1 0 1	DL7		DL7						"	"	" "
0 1 0 0	DL8		DL8						"	"	" "
1 1 0 0	DL9		DL9						"	"	" "
1 1 0 1	DL10		DL10						"	"	" "
1 1 1 0	DL11		DL11						"	"	" "
1 1 1 0	DL12		DL12						NONE		NONE
1 0 0 1	DL13		DL13						Port Star-board off		Fore Aft off
1 0 0 0	DL14		DL14						"	"	" "
1 0 1 1	DL15		DL15						"	"	" "
1 1 1 1	DL16		DL16						NONE		NONE

	Tone Pair Activate	Advance Tone Pair	Parametric Select						
	JK	NK	JK	NK	JK				
0 1 1 0	SLM on		SLM Opt 1		SLM Opt 2		Not Used		Not used
0 1 0 1	Adjustable Threshold on	NK	JK Level A	NK	JK Level B	NK	JK Adj thres Opt 1	NK	JK Adj Thres Opt 2

* Opt 1 & Opt 2 Refer to Down-link Reassignment

Figure 5A

7107 A and B

PAYLOAD 173 & 174

Command Options

7107 C and D

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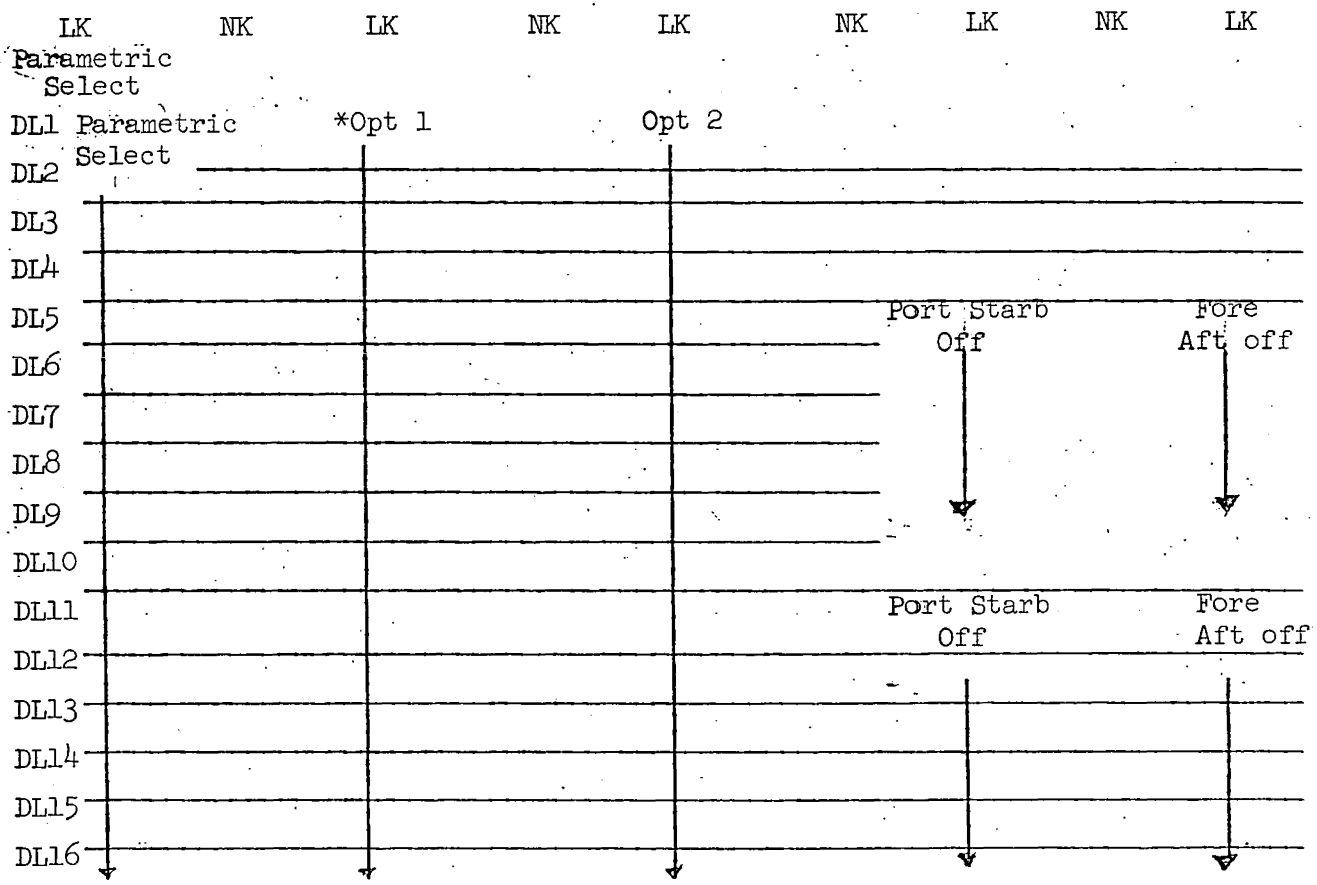
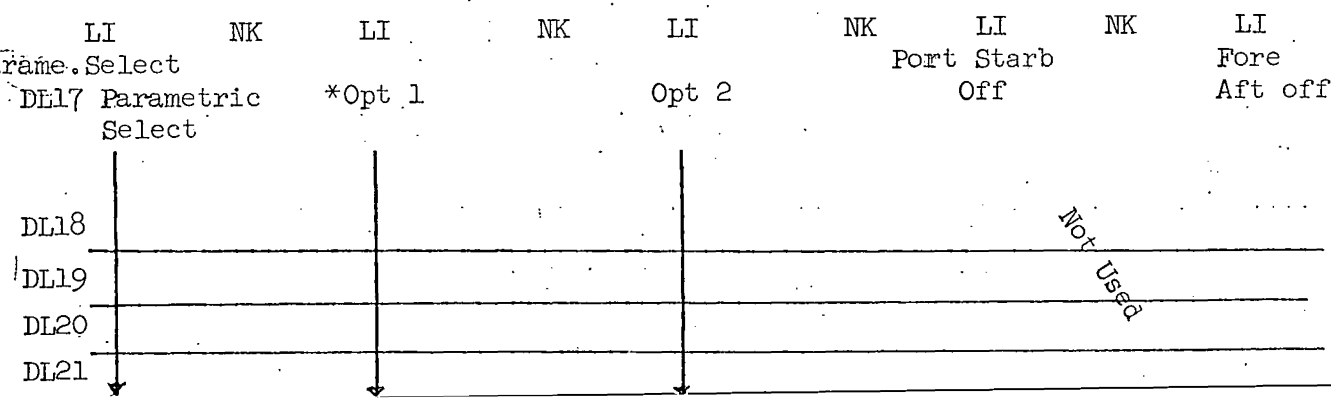
Address Register States Primary Cmds F_1 F_2 F_3 F_4	Tone Pair Activate LK Primary Cmds	Advance Tone Pair NK
0 0 0 0	DL1	
0 0 0 1	DL2	
0 0 1 1	DL3	
0 0 1 0	DL4	
0 1 1 0	DL5	
0 1 1 1	DL6	
0 1 0 1	DL7	
0 1 0 0	DL8	
1 1 0 0	DL9	
1 1 0 1	DL10	
1 1 1 0	DL11	
1 0 1 0	DL12	
1 0 0 1	DL13	
1 0 0 0	DL14	
1 0 1 1	DL15	
1 1 1 1	DL16	



Tone Pair Activate LI	Advance Tone Pair NK
0 1 1 0 DL17	
0 1 1 1 DL18	
0 1 0 1 DL19	
0 1 0 0 DL20	
1 1 0 0 DL21	



Address Register States	Tone Pair Activate	Advance							
	JK	NK	JK	NK	JK				
0 1 1 0	SLM on		SLM Opt 1		SLM Opt 2		Not Used		Not used
0 1 0 1	Adjustable Threshold on	NK	JK Level A	NK	JK Level B	NK	JK Adj Thres Opt 1	NK	JK Adj Thres Opt 2

* Opt 1 & Opt 2 Refer to Down-link Reassignment

COMMAND REGISTER STATES F_1 F_2 F_3 F_4	DL17 Enable 0010LI	Advance NK	Column #1 Activate LI		Column #2 LI		Column #3 LI
1 1 0 0			17_1		17_2		17_3
1 1 0 1			17_4		17_5		17_6
1 1 1 0			17_7		17_8		17_9
1 0 1 0			17_{10}		17_{11}		17_{12}
1 0 0 1			17_{13}		17_{14}		17_{15}
1 0 0 0			17_{16}		17_{17}		17_{18}
1 0 1 1			17_{19}		17_{20}		

BAND 17 PL 171 & 172

COMMAND MATRIX

Figure 5C

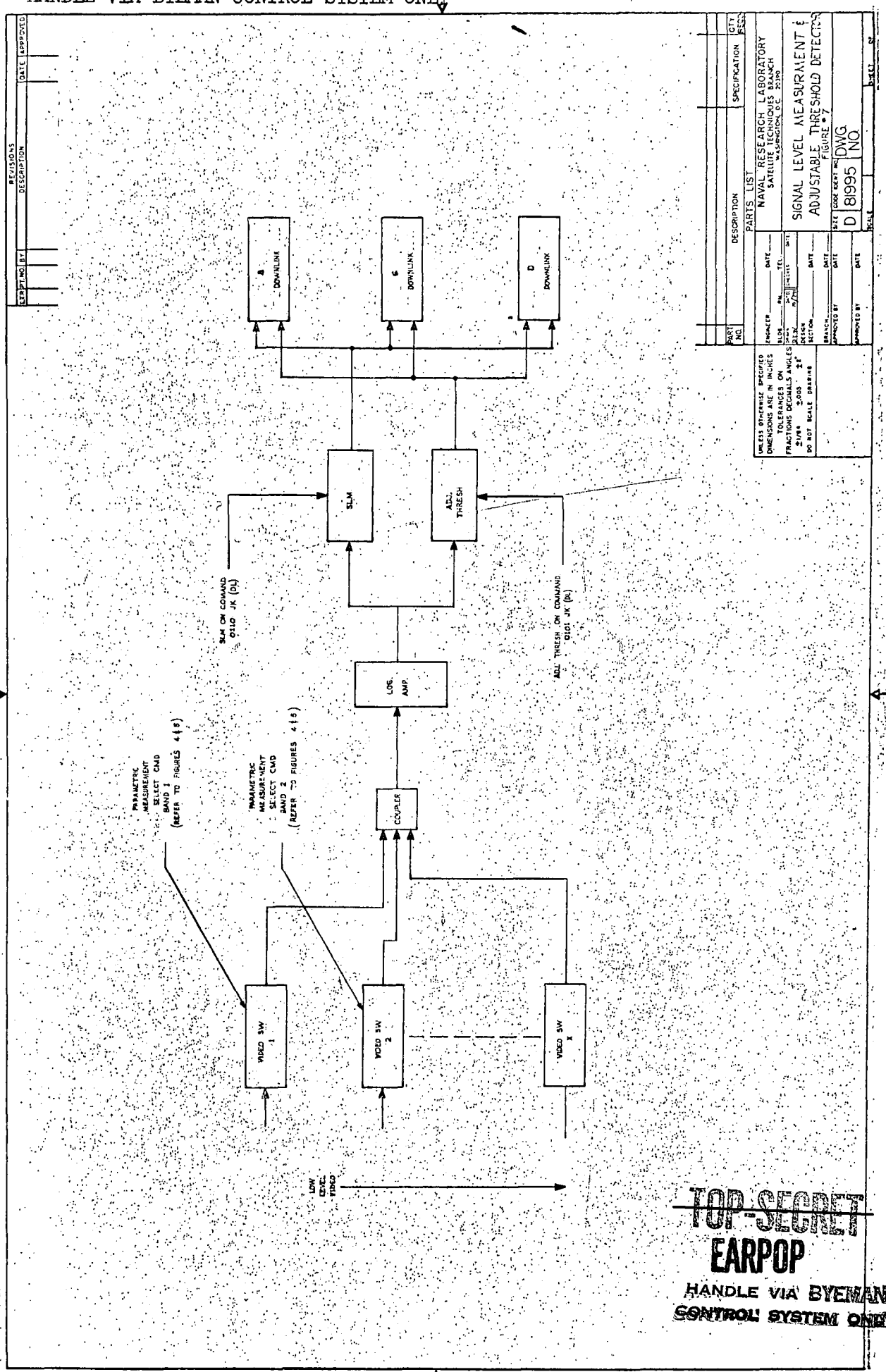
COMMAND SYSTEM OPERATION

Figure 6

7107 PROGRAMMABLE TIMER

	CMD #1 (1111-LI) 3 State Counter	CMD #2 (1111-JL) 5 State Counter	
Condition Upon Enabling	100	10000	
	010	01000	140 Minutes
	001	00100	130 of
	100	00010	120 Delay
	010	00001	110
	001	10000	100
	100	01000	90
	010	00100	80
	001	00010	70
	100	00001	60
	010	10000	50
	001	01000	40
	100	00100	30
	010	00010	20
	001	00001	10
	100	10000	

Time Delay Desired Minutes	# of Times CMD #1 must be sent	# of Times CMD #2 must be sent
10	2	4
20	1	3
30	0	2
40	2	1
50	1	0
60	0	4
70	2	3
80	1	2
90	0	1
100	2	0
110	1	4
120	0	3
130	2	2
140	1	1



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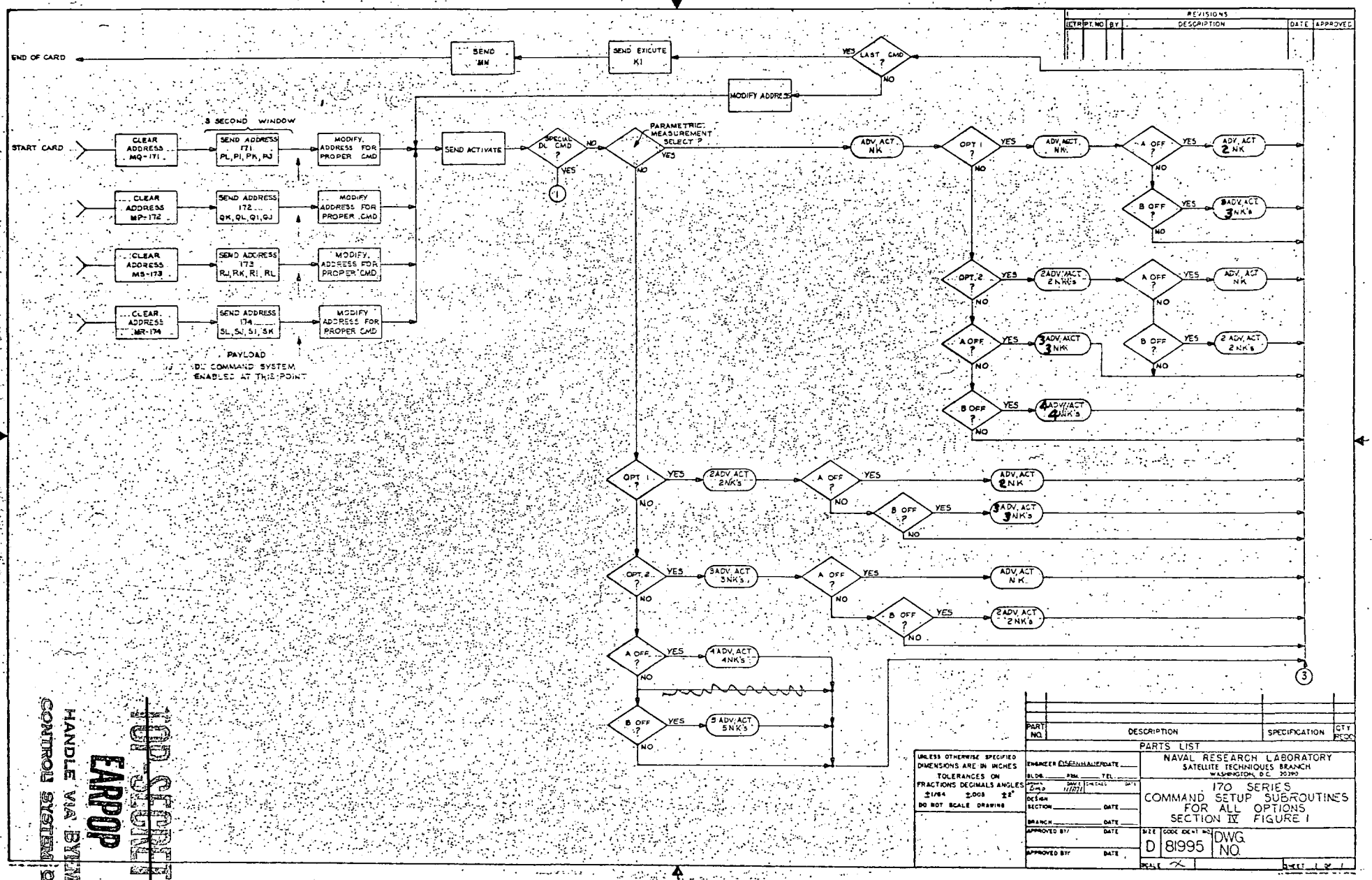

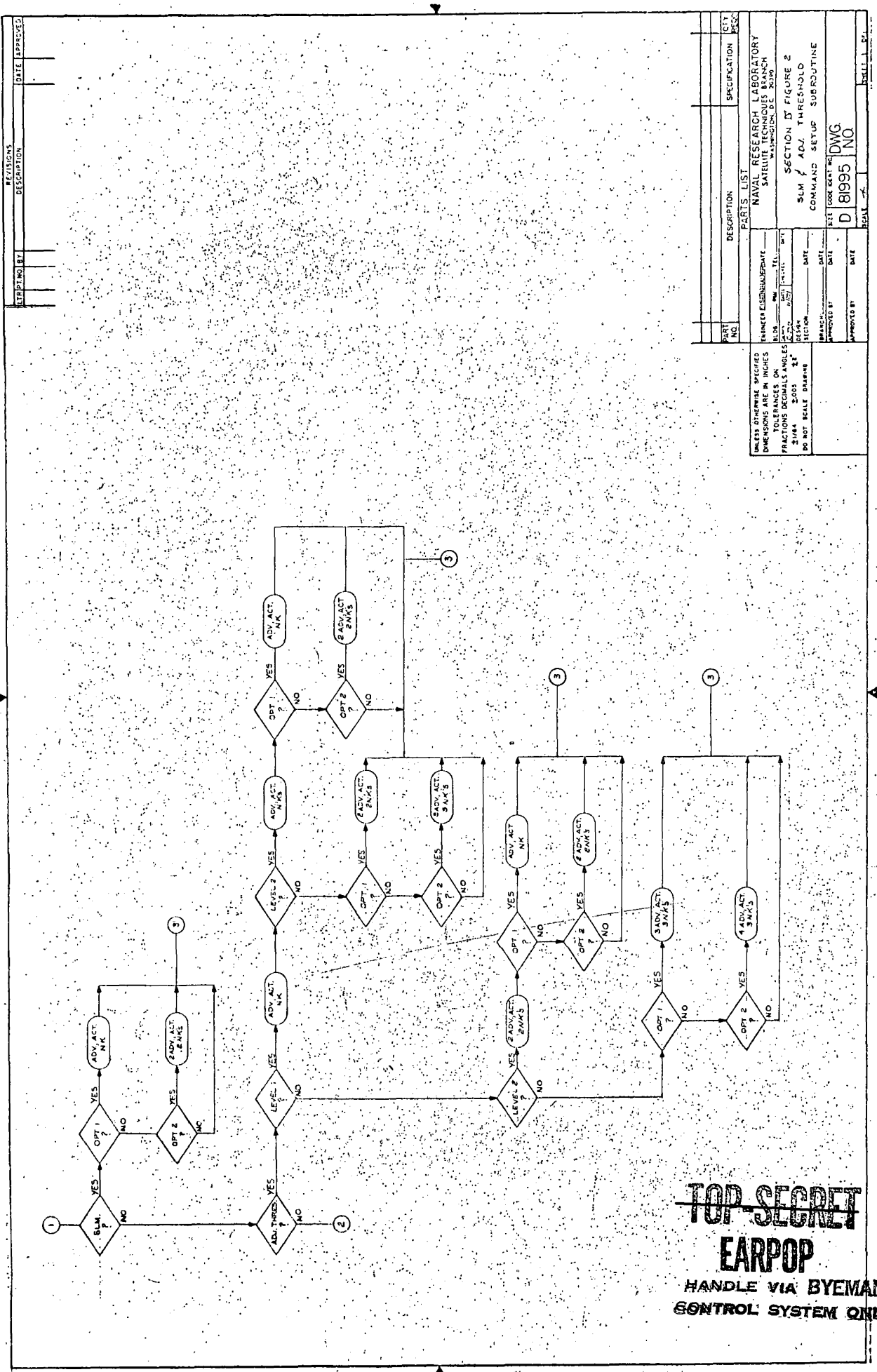

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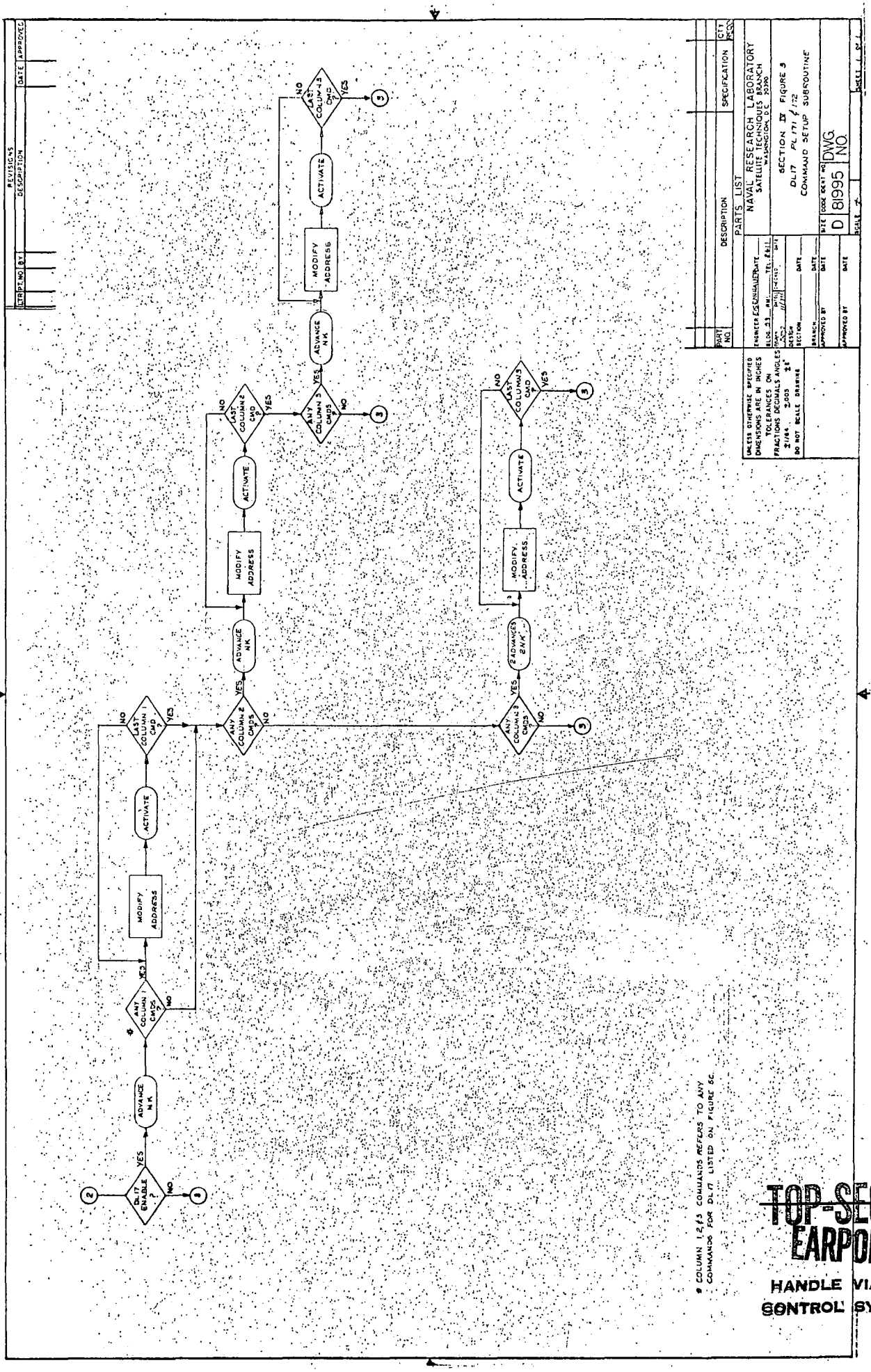

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EXP 171 - 174 CH 5 (DL) RPI ALLOCATION 10/15/71

SEG NO.	FUNCTION	%	VOLTS	DESCRIPTION
1	OV CAL	0	0	LO BAND EDGE CAL
2	5V CAL	100	5	HI BAND EDGE CAL
3	DL 1 RPI	10	.5	DL 1 OFF; SLM OFF
		54	2.7	DL 1 ON; SLM OFF
		74	3.7	DL 1 ON; SLM ON
4	DL 2 RPI	20	1	DL 2 OFF; SLM OFF
		60	3	DL 2 ON; SLM OFF
		72	3.6	DL 2 ON; SLM ON
5	DL 3 RPI	10	.5	DL 3 OFF; SLM OFF
		54	2.7	DL 3 ON; SLM OFF
		74	3.7	DL 3 ON; SLM ON
6	DL 4 RPI	20	1	DL 4 OFF; SLM OFF
		60	3	DL 4 ON; SLM OFF
		72	3.6	DL 4 ON; SLM ON
7	DL 5 RPI	10	.5	DL 5 OFF; SLM OFF
		54	2.7	DL 5 ON; SLM OFF
		74	3.7	DL 5 ON; SLM ON
8	DL 6 RPI	20	1	DL 6 OFF; SLM OFF
		60	3	DL 6 ON; SLM OFF
		72	3.6	DL 6 ON; SLM ON
9	DL 7 RPI	10	.5	DL 7 OFF; SLM OFF
		54	2.7	DL 7 ON; SLM OFF
		74	3.7	DL 7 ON; SLM ON
10	DL 8 RPI	20	1	DL 8 OFF; SLM OFF
		60	3	DL 8 ON; SLM OFF
		72	3.6	DL 8 ON; SLM ON
11	DL 9 RPI	10	.5	DL 9 OFF; SLM OFF
		54	2.7	DL 9 ON; SLM OFF
		74	3.7	DL 9 ON; SLM ON

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HANDLE VIA BYEMAN CONTROL SYSTEM ONLY

SEG NO.	FUNCTION	%	VOLTS	DESCRIPTION
12	DL 10 RPI	20	1	DL 10 OFF; SLM OFF
		60	3	DL 10 ON; SLM OFF
		72	3.6	DL 10 ON; SLM ON
13	DL 11 RPI	10	.5	DL 11 OFF; SLM OFF
		54	2.7	DL 11 ON; SLM OFF
		74	3.7	DL 11 ON; SLM ON
14	DL 12 RPI	20	1	DL 12 OFF; SLM OFF
		60	3	DL 12 ON; SLM OFF
		72	3.6	DL 12 ON; SLM ON
15	DL 13 RPI	10	.5	DL 13 OFF; SLM OFF
		54	2.7	DL 13 ON; SLM OFF
		74	3.7	DL 13 ON; SLM ON
16	DL14 RPI	20	1	DL 14 OFF; SLM OFF
		60	3	DL 14 ON; SLM OFF
		72	3.6	DL 14 ON; SLM ON
17	DL 15 RPI	10	.5	DL 15 OFF; SLM OFF
		54	2.7	DL 15 ON; SLM OFF
		74	3.7	DL 15 ON; SLM ON
18	DL 16 RPI	20	1	DL 16 OFF; SLM OFF
		60	3	DL 16 ON; SLM OFF
		72	3.6	DL 16 ON; SLM ON
19	DL 17 RPI (173, 174 ONLY)	10	.5	DL 17 OFF; SLM OFF
		54	2.7	DL 17 ON; SLM OFF
		74	3.7	DL 17 ON; SLM ON
20	DL 18 RPI (173, 174 ONLY)	20	1	DL 18 OFF; SLM OFF
		60	3	DL 18 ON; SLM OFF
		72	36	DL 18 ON; SLM ON

EXP 171- 174 CH 5 (DL) RPI ALLOCATIONS 10/15/71

SEG NO.	FUNCTION	%	VOLTS	DESCRIPTION
21	DL 19 RPI (173, 174 ONLY)	10	.5	DL 19 OFF; SLM OFF
		54	2.7	DL 19 ON; SLM OFF
		74	3.7	DL 19 ON; SLM ON
22	DL 17 TSK GRP 1,2SELECT (171, 172 ONLY)	20	1	DL 17 TSK GRP 1 OFF; 2 OFF
		40	2	DL 17 TSK GRP 1 OFF; 2 ON
		60	3	DL 17 TSK GRP 1 ON; 2 OFF
		72	3.6	DL 17 TSK GRP 1 ON; 2 ON
23	DL 17 TSK GRP 3, 4 SELECT (171, 172 ONLY)	10	.5	DL 17 TSK GRP 3 OFF; 4 OFF
		40	2	DL 17 TSK GRP 3 OFF; 4 ON
		54	2.7	DL 17 TSK GRP 3 ON; 4 OFF
		74	3.7	DL 17 TSK GRP 3 ON; 4 ON
22	DL 20 RPI (173, 174 ONLY)	20	1	DL 20 OFF; SLM OFF
		60	3	DL 20 ON; SLM OFF
		72	3.6	DL 20 ON; SLM ON
23	DL 21 & DL 22 RPI (173, 174 ONLY)	10	.5	DL 21 OFF; DL 22 OFF
		40	2	DL 21 OFF; DL 22 ON
		54	2.7	DL 21 ON; DL 22 OFF
		74	3.7	DL 21 ON; DL 22 ON
24	DL ENABLE RPI	20	1	DL ENABLE ON
		60	3	DL ENABLE OFF
25	EXECUTE RPI DL SYS ON RPI	20	1	EXECUTE ON; DL SYS OFF
		40	2	EXECUTE ON; DL SYS ON
		60	3	EXECUTE OFF: DL SYS OFF
26	PL ID	20	1	PL 171
		40	2	PL 172
		60	3	PL 173
		80	4	PL 174
27	BU DL SYSTEM ON RPI	20	1	BU DL SYS OFF
		60	3	BU DL SYS ON

EXP 171- 174 CH 5 (DL) RPI ALLOCATIONS 10/15/71

SEG NO.	FUNCTION	%	VOLTS	DESCRIPTION
28	SLM-ADJ THRESH RPI	8	.4	RESET (PARAMETRIC OFF)
		34	1.7	SLM SELECTED
		52	2.6	ADJ THRESHOLD SELECTED
		74	3.6	SLM & ADJ THRESH. SEL
29	DL CONV ON-BYP RPI	20	1	DL CONV BYP; CONV 2 SEL
	DL CONV PRIM-SEC RPI	40	2	DL CONV BYP; CONV 1 SEL
		60	3	DL CONV ON; CONV 2 SEL
		80	4	DL CONV ON; CONV 1 SEL
30	DL TIMER LONG-SHORT RPI	20	1	DL TIMER LONG
		60	3	DL TIMER SHORT (20 MIN)
31	TIMER CMD 1 INDICATOR	0	0	100
		20	1	010
		40	2	001
32	TIMER CMD 2 INDICATOR	0	0	10000
		20	1	01000
		40	2	00100
		60	3	00010
		80	4	00001

EXP 171 - 174 CH 6 (HK) RPI ALLOCATIONS 10/15/71

SEG NO.	FUNCTION	%	VOLTS	DESCRIPTION
1	OV CALIBRATE	0	0	LO BAND EDGE CAL
2	5V	100	5.00	HI BAND EDGE CAL
3	PKG TEMP			V↑ AS T↓
4	PRIM PLUS BATT TEMP			V↑ AS T↓
5	P.L. ID	20	1	PL 171
		40	2	PL 172
		60	3	PL 173
		80	4	PL 174
6	-VOLTAGE SENSOR	0	0	-10 VOLTS
		100	5	-14 VOLTS
7	+ VOLTAGE SENSOR	0	0	+10 VOLTS
		100	5	+14 VOLTS
8	ADDRESS 1A IND	20	1	ADDRESS 1 SENT
	ADDRESS 1B IND	40	2	
		60	3	
		80	4	RESET OR DIG 1 SENT
9	ADDRESS 2A IND	20	1	ADDRESS 1, 2 SENT
	ADDRESS 2B IND	40	2	
		60	3	
		80	4	RESET OR DIG 1 SENT
10	ADDRESS 3A IND	20	1	ADDRESS 1, 2, 3, SENT
	ADDRESS 3B IND	40	2	
		60	3	
		80	4	RESET OR DIG 1 SENT
11	ADDRESS 4A IND	20	1	ADDRESS 1, 2, 3, 4 SENT
	ADDRESS 4B IND	40	2	
		60	3	
		80	4	RESET OR DIG 1 SENT
12	CMD ENABLE RPI	20	1	CMD ENAB ON; BU OFF
	BU CMD SYS. RPI	40	2	CMD ENAB ON;: BU ON
		60	3	CMD ENAB OFF; BU OFF
		80	4	CMD ENAB OFF;BU ON

EXP 171 - 174 CH 6 (HK) RPI ALLOCATIONS 10/15/71

SEG NO.	FUNCTION	%	VOLTS	DESCRIPTION	
13	ORDNANCE ENABLE RPI ALT ORDNANCE ENAB RPI	36 40 60 80	1.8 2 3 4	ORD ENAB OFF; ALT ORD ENAB OFF ORD ENAB OFF; ALT ORD ENAB ON ORD ENAB ON; ALT ORD ENAB OFF ORD ENAB ON; ALT ORD ENAB ON	
14	SEPARATION IND DL BOOM RELEASE IND	36 40 60 80	1.8 2 3 4	PL NOT SEP; DL BOOM NOT REL PL NOT SEP; DL BOOM REL PL SEPARATED; DL BOOM NOT REL PL SEPARATED; DL BOOM REL	
15	PRIM MINUS BATT TEMP			V ↑ AS T ↓	
16	CMD TT (1) CMD TT (2)	20 40 56 70	1 2 2.8 3.5	CMD TT 1 OFF; CMD TT 2 OFF CMD TT 1 OFF; CMD TT 2 ON CMD TT 1 ON; CMD TT 2 OFF CMD TT 1 ON; CMD TT 2 ON	
17	BOOM LENGTH IND			V ↑ AS BOOM LENGTH ↑	
18	BOOM ON-OFF RPI BOOM IN-OUT RPI	20 40 60 80	1 2 3 4	BOOM OFF; BOOM IN BOOM OFF; BOOM OUT BOOM ON; BOOM IN BOOM ON; BOOM OUT	
19	BOOM TIP MASS REL IND BOOM FULL EXT IND	20 60 80 20	1 3 4 1	TIP MASS NOT RELEASED TIP MASS REL; BOOM NOT FULL EXT TIP MASS REL; BOOM FULL EXT BOOM OFF	
20	BOOM FULL RETRACT IND BOOM MID IND 7(	46 36 64 36	2.3 1.8 3.2 1.8	REST BOOM EXTENDS BOOM EXT PAST MID POS. BOOM RET. TO MID POS.	FULL RET; NOT MID NOT F.R.; NOT MID NOT F.R.; NOT MID NOT F.R.; MID
21	SPARE				
22	REC 1 AGC			V ↑ AS SIGNAL LEVEL ↑	
23	REC 2 AGC			V ↑ AS SIGNAL LEVEL ↑	

EXP 171 - 174 CH 6 (HK) RPI ALLOCATIONS 10/15/71

SEG NO.	FUNCTION	%	VOLTS	DESCRIPTION
24	PRIM-SEC +BATT SEL RPI	20	1	SEC + BATT SEL; SEC -BATT SEL
	PRIM-SEC -BATT SEL RPI	40	2	SEC + BATT SEL; PRIM -BATT SEL
		60	3	PRIM + BATT SEL; SEC -BATT SEL
		80	4	PRIM + BATT SEL; PRIM -BATT SEL
25	BATT BYP ON-OFF RPI	20	1	BATT BYP OFF; BATT BYP ENAB OFF
	BATT BYP ENAB ON-OFF RPI	40	2	BATT BYP OFF; BATT BYP ENAB ON
		60	3	BATT BYP ON; BATT BYP ENAB OFF
		80	4	BATT BYP ON; BATT BYP ENAB ON
26	CH CON ON-OFF RPI	20	1	CH CON OFF; LO CH
	CH CON HI-LO CH RPI	40	2	CH CON OFF; HI CH
		60	3	CH CON ON; LO CH
		80	4	CH CON ON; HI CH
27	+SC I MON	0	0	0 AMPS
		100	5	1.5 AMPS
28	-SC I MON	0	0	0 AMPS
		100	5	1.5 AMPS
29	+CH I MON	0	0	0 AMPS
		100	5	1 AMPS
30	+DISCH I MON	0	0	0 AMPS
		100	5	1 AMPS
31	-CH I MON	0	0	0 AMPS
		100	5	1 AMPS
32	-DISCH I MON	0	0	0 AMPS
		100	5	1 AMPS

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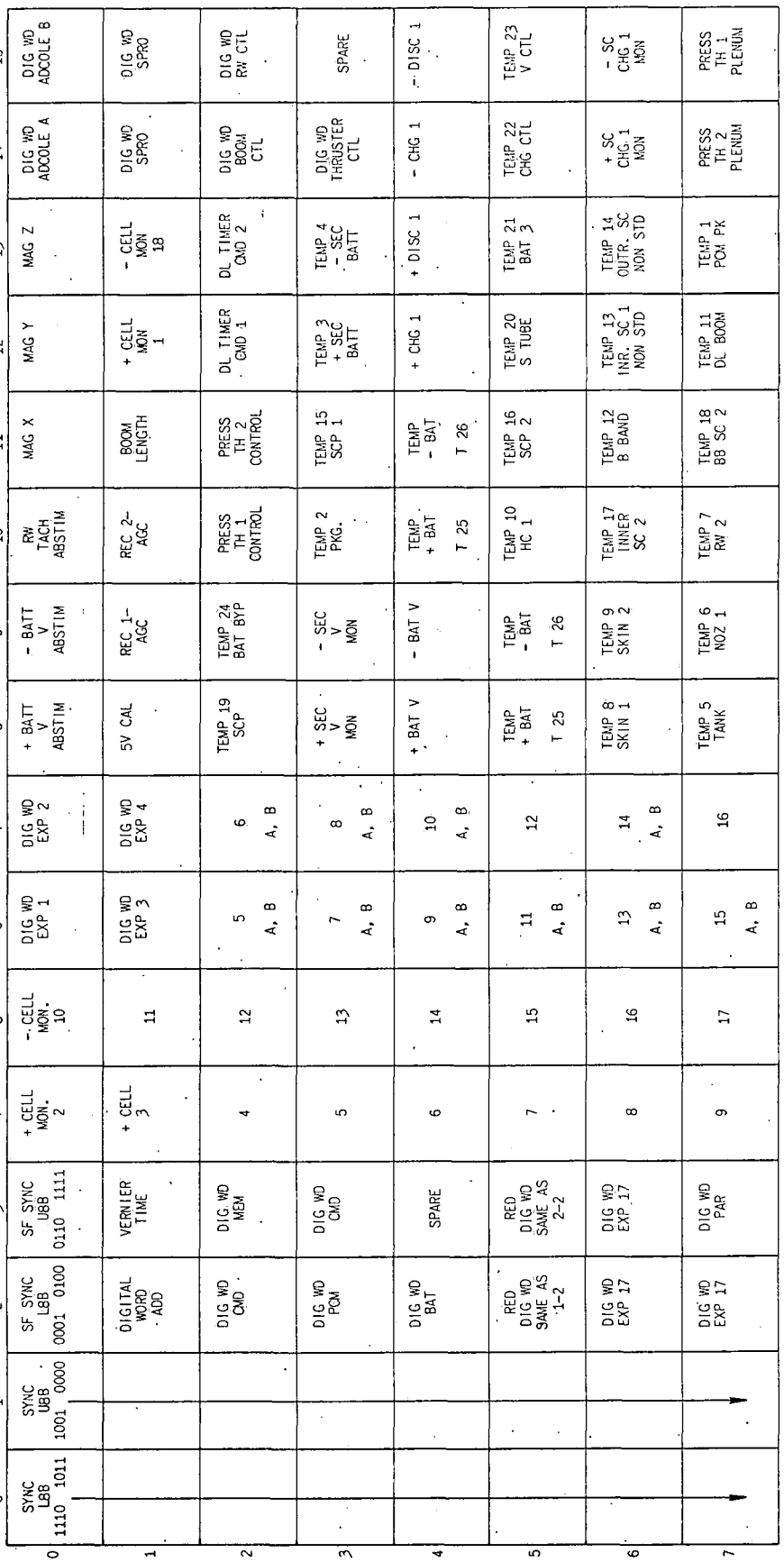
EXP 171 - 174 CH 7(ASP) RPI ALLOCATIONS 10/15/71

SEG NO.	FUNCTION	%	VOLTS	DESCRIPTION
1	OV CAL	0	0	LO BAND EDGE CAL
2	5V CAL	100	5	HI BAND EDGE CAL
3	SOLAR ASPECT VERT BIT 1A			.15V -SENSOR BIT ILLUMINATED 4.3V -SENSOR BIT NOT ILLUMINATED
4	2A			
5	3A			
6	4A			
7	5A			
8	6A			
9	7A			
10	HORIZ 1B			
11	2B			
12	3B			
13	4B			
14	5B			
15	6B			
16	7B			
17	ID 1			"0" = .15V Code -10 = Sensor 1 "1" = 4.3 V 01 = Sensor 2 11 = Sensor 3
18	ID 2			
19	X AXIS MAG			2.43V = 0 FLUX
20	Y AXIS MAG			2.43V = 0 FLUX
21	Z AXIS MAG			2.43V = 0 FLUX
22	+SEC VOLT MON	27	2.85	+8V
		100	5	+14V
23	-SEC VOLT MON	0	0	-10 VOLTS
		100	5	-14 VOLTS
24	THRUSTER 1 ON-OFF RPI	20	1	TH 1 OFF; TH 2 OFF
	THRUSTER 2 ON-OFF RPI	40	2	TH 1 OFF; TH 2 ON
		60	3	TH 1 ON; TH 2 OFF
		80	4	TH 1 ON; TH 2 ON

EXP 171-174 CH 7(ASP)RPI ALLOCATIONS 10/29/71

SEG NO.	FUNCTION	%	VOLTS	DESCRIPTION
25	THRUST 1 HEAT ON-OFF RPI	20	1	TH 1 HEAT OFF; TH 2 HEAT OFF
	THRUST 2 HEAT ON-OFF RPI	40	2	TH 1 HEAT OFF; TH 2 HEAT ON
		60	3	TH 1 HEAT ON; TH 2 HEAT OFF
		80	4	TH 1 HEAT ON; TH 2 HEAT ON
26	HI-LO THRUST SEL RPI	20	1	HI THRUST
		60	3	LO THRUST
27	THRUSTER 1 PRESS	0	0	0 PSI
	(CONTROL X DUCER)	100	5	50 PSI
28	THRUSTER 2 PRESS	0	0	0 PSI
	(CONTROL X DUCER)	100	5	50 PSI
29	RW ON-OFF RPI	20	1	RW OFF; RW REV
	RW FWD-REV RPI	50	2.5	RW OFF; RW FWD
		66	3.3	RW ON; RW REV
		80	4	RW ON; RW FWD
30	RW PRIM-SEC CONTROL RPI	20	1	RW PRIM CON; RW SEC PA
	RW PRIM-SEC PA RPI	46	2.3	RW PRIM CON; RW PRIM PA
		70	3.5	RW SEC CON; RW SEC PA
		84	4.2	RW SEC CON; RW PRIM PA
31	RW SPEED MON ON-OFF RPI	20	1	RW SP MON OFF
		60	3	RW SP MON ON
32	RW TACH	0	0	ORPS
		72	3.6	14.66 RPS (OPERATING POINT)
		98	4.9	22 RPS



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	SYNC L8B 1110 1011	SYNC U8B 1001 0000	SF SYNC L8B 0001 0100	SF SYNC U8B 0110 1111	+ CELL MON. 2	-CELL MON. 10	DIG WD EXP 1	DIG WD EXP 2	+ BATT V ABSTIM	- BATT V ABSTIM	RW TACH ABSTIM	MAG X	MAG Y	MAG Z	DIG WD ADCOLE A	DIG WD ADCOLE B
1			DIGITAL WORD ADD	VERNIER TIME	+ CELL 3	11	DIG WD EXP 3	DIG WD EXP 4	5V CAL	REC 1- AGC	REC 2- AGC	BOOM LENGTH	+ CELL MON 1	- CELL MON 18	DIG WD BOOM CTL	DIG WD SPRO
2			DIG WD CMD	DIG WD MEM	4	12	5 A, B	6 A, B	TEMP 19 SCP	TEMP 24 BAT BYP	PRESS TH 1 CONTROL	PRESS TH 2 CONTROL	DL TIMER CMD 1	DL TIMER CMD 2	DIG WD THRUSTER CTL	DIG WD RW CTL
3			DIG WD PCM	DIG WD CMD	5	13	7 A, B	8 A, B	+ SEC V MON	- SEC V MON	TEMP 2 PKG.	TEMP 15 SCP 1	TEMP 3 + SEC BATT	TEMP 4 - SEC BATT	+ DISC 1	SPARE
4			DIG WD BAT	SPARE	6	14	9 A, B	10 A, B	+ BAT V	- BAT V	TEMP + BAT T 25	TEMP - BAT T 26	+ CHG 1	+ DISC 1	- CHG 1	- DISC 1
5			RED DIG WD SAME AS 1-2	RED DIG WD SAME AS 2-2	7	15	11 A, B	12	TEMP + BAT T 25	TEMP - BAT T 26	TEMP 10 HC 1	TEMP 16 SCP 2	TEMP 20 S TUBE	TEMP 21 BAT 3	TEMP 22 CHG CTL	TEMP 23 V CTL
6			DIG WD EXP 17	DIG WD EXP 17	8	16	13 A, B	14 A, B	TEMP 8 SKIN 1	TEMP 9 SKIN 2	TEMP 17 INNER SC 2	TEMP 12 B BAND	TEMP 13 INR. SC 1 NON STD	TEMP 14 OUTR. SC NON STD	+ SC CHG 1 MON	- SC CHG 1 MON
7			DIG WD EXP 17	DIG WD PAR	9	17	15 A, B	16	TEMP 5 TANK	TEMP 6 NOZ 1	TEMP 7 RW 2	TEMP 18 BB SC 2	TEMP 11 DL BOOM	TEMP 1 PCM PK	PRESS TH 2 PLENUM	PRESS TH 1 PLENUM

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~~TOP SECRET~~
EARPOP
HANDLE VIA BYEMAN
CONTROL SYSTEM ONLY

~~TOP SECRET~~
HANDLE VIA BYEMAN
CONTROL SYSTEM ONLY

~~TOP SECRET~~
BYE 51914-71

Handle VIA BYEMAN CONTROL SYSTEM ONLY

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	SYNC L8B 1110 1011	SYNC U8B 1001 0000	SF SYNC L8B 0001 0100	SF SYNC U8B 0110 1111	+ CELL MON. 2	- CELL MON. 10	DIG WD EXP 1	DIG WD EXP 2	+ BATT V ABSTIM	- BATT V ABSTIM	RW TACH ABSTIM	MAG X	MAG Y	MAG Z	DIG WD ADCOLE A	DIG WD ADCOLE B
1			DIGITAL WORD ADD	VERNIER TIME	+ CELL 3	11	DIG WD EXP 3	DIG WD EXP 4	5V CAL	REC 1- AGC	REC 2- AGC	BOOM LENGTH	+ CELL MON 1	- CELL MON 18	DIG WD SPRO	DIG WD SPRO
2			DIG WD CMD	DIG WD MEM	4	12	5 A, B	6 A, B	TEMP 19 SCP	TEMP 24 BAT BYP	PRESS TH 1 CONTROL	PRESS TH 2 CONTROL	DL TIMER CMD 1	DL TIMER CMD 2	DIG WD BOOM CTL	DIG WD RW CTL
3			DIG WD PCM	DIG WD CMD	5	13	7 A, B	8 A, B	+ SEC V MON	- SEC V MON	TEMP 2 PKG.	TEMP 15 SCP 1	TEMP 3 + SEC BATT	TEMP 4 - SEC BATT	DIG WD THRUSTER CTL	SPARE
4			DIG WD BAT	EXP 17 A, B	6	14	9 A, B	10	+ BAT V	- BAT V	TEMP + BAT T 25	TEMP - BAT T 26	+ CHG 1	+ DISC 1	- CHG 1	- DISC 1
5			EXP 18	EXP 19	7	15	11 A, B	12	TEMP + BAT T 25	TEMP - BAT T 26	TEMP 10 HC 1	TEMP 16 SCP 2	TEMP 20 S TUBE	TEMP 21 BAT 3	TEMP 22 CHG CTL	TEMP 23 V CTL
6			EXP 20	EXP 21	8	16	13 A, B	14 A, B	TEMP 8 SKIN 1	TEMP 9 SKIN 2	TEMP 17 INNER SC 2	TEMP 12 B BAND	TEMP 13 INR. SC 1 NON STD	TEMP 14 OUTR. SC NON STD	+ SC CHG 1 MON	- SC CHG 1 MON
7			RETEP	PAR	9	17	15 A, B	16	TEMP 5 TANK	TEMP 6 NOZ 1	TEMP 7 RW 2	TEMP 18 BB SC 2	TEMP 11 DL BOOM	TEMP 1 POM PK	PRESS TH 2 PLENUM	PRESS TH 1 PLENUM

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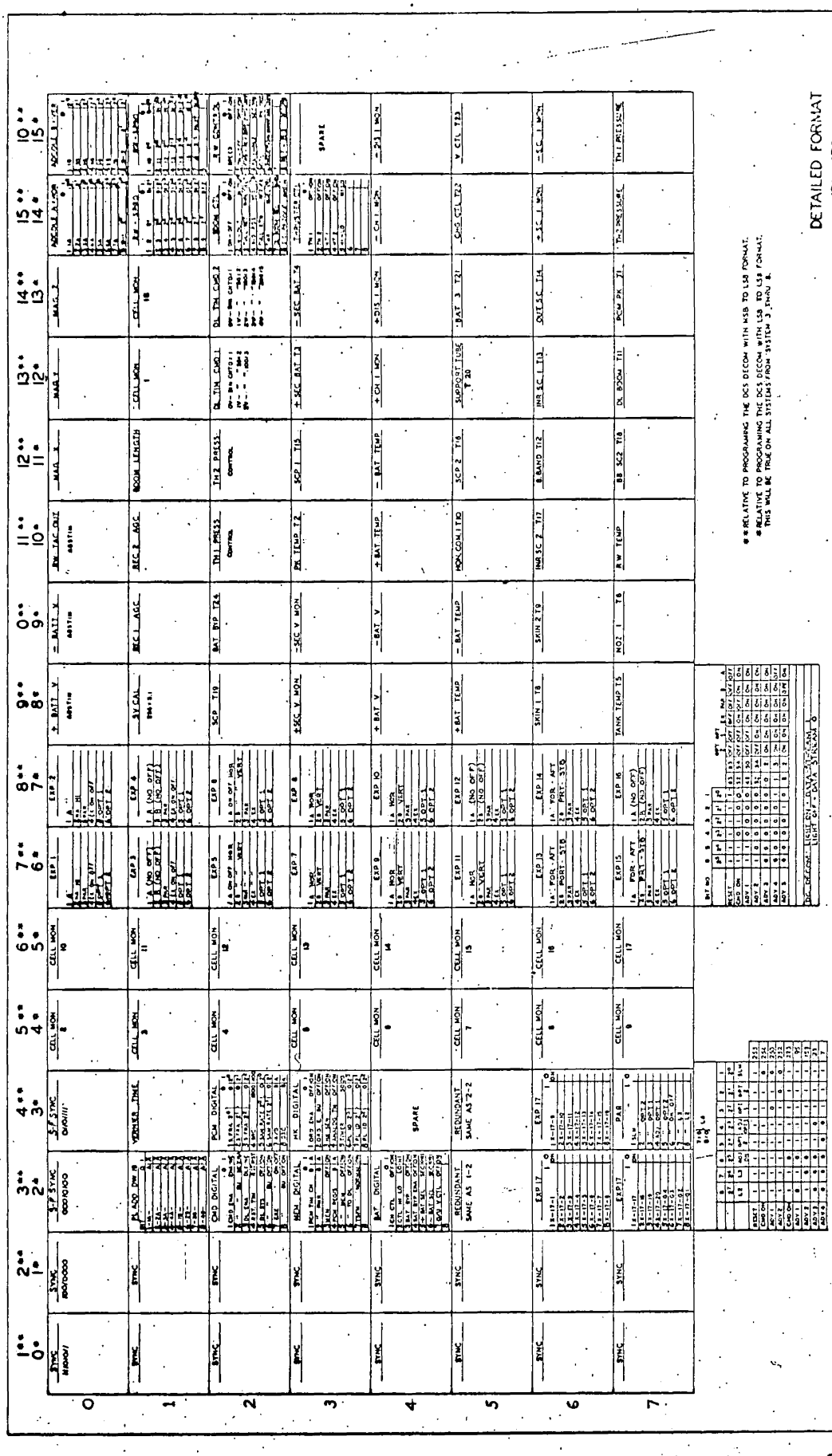

DETAILED FORMAT
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