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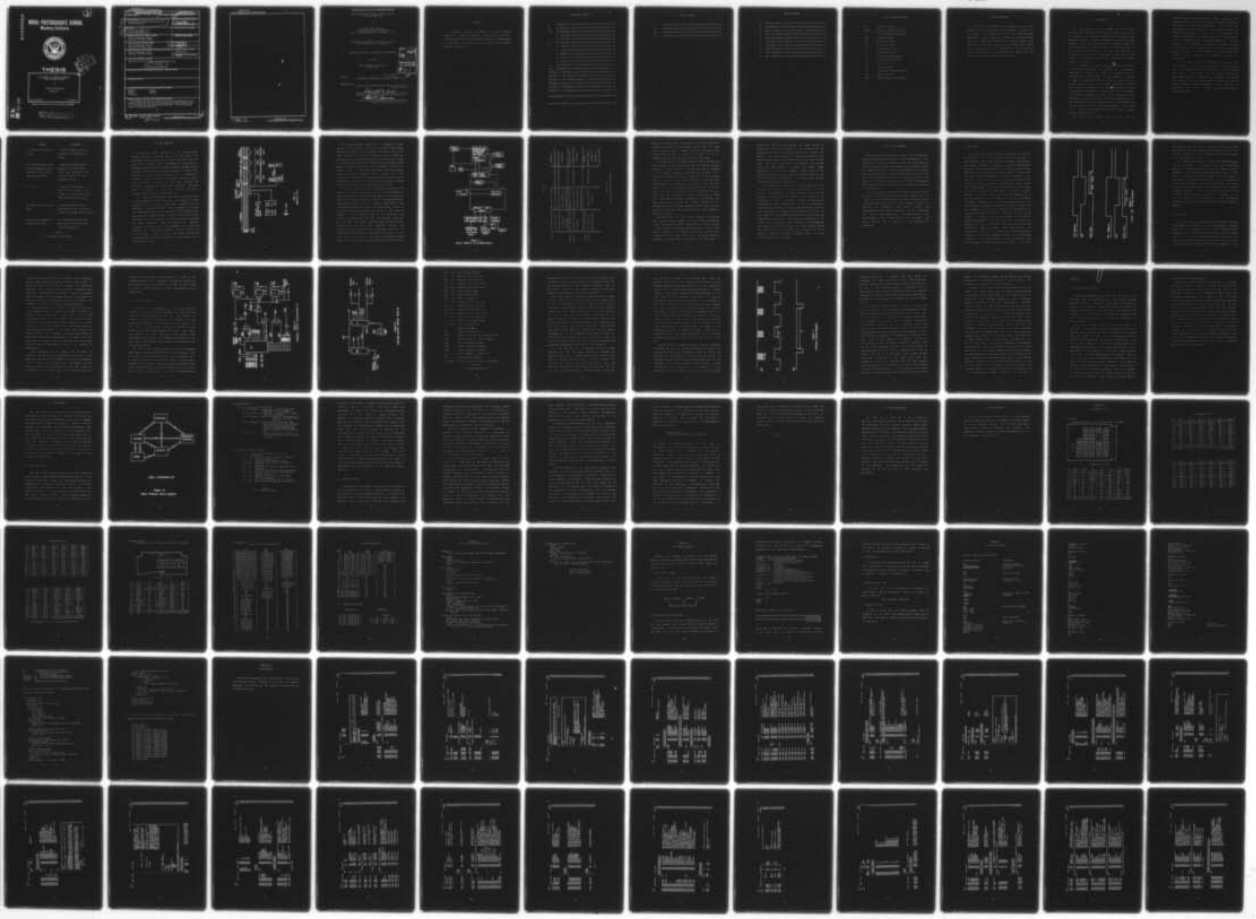

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NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

AN INTERACTIVE COMPUTER INTERFACE
WITH A DIGITAL RECEIVER

by

William Glenn Borries

March 1977

Thesis Advisor: S. Jauregui

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A computer interface to connect both the Applied Technology Airborne Computer (ATAC) and the KIM-1 Microprocessor to a Watkins Johnson digitally tuned receiver was designed and constructed. The existing ATAC computer program was modified.

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An Interactive Computer Interface with a Digital Receiver

by

William Glenn Borries
Lieutenant, United States Navy
B.S., United States Naval Academy, 1970

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN ELECTRICAL ENGINEERING

from the

NAVAL POSTGRADUATE SCHOOL
March, 1977

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LIST OF ABBREVIATIONS

A/D	Analog to Digital
ASCII	American Standard Code for Information Interchange
Baud	Bits per second
D/A	Digital to Analog
high	TTL logic 1 (+5v)
I/O	Input and/or Output
IC	Integrated Circuit
IF	Intermediate Frequency
ISB	Intermediate Sideband
low	TTL logic 0 (0v)
LSB	Lower Sideband
TTL	Transistor Transistor Logic
USB	Upper Sideband
BFO	Beat Frequency Oscillator

ACKNOWLEDGEMENTS

I would like to express my deep appreciation to Carole Hickey who wrote the initial ATAC programs. Without her Main System the programming that I did would have been unbearable. I would also like to thank the following people who have helped along the way: LT. Al May, Al Gilkes, Greg Ramos, LT. Bill Hickey, Bob Glaz, Dave Blonden, Dean Hayes, and Virginia Ward. Most importantly, I want to thank my wife, Cathy, for all the encouragement and advice she has given me during the writing of this thesis.

I. INTRODUCTION

For many decades man has dreamed of the day when machines could relieve him of much of his work. In this era of computers and advanced technology, this dream is now becoming a reality. Connecting computers to other machines, however, is not just a simple matter of running a wire from one to the other. In order for the computer to be able to use its "thinking" ability, it must have some way to translate its signals into a form that is recognized by the machine it is controlling. This is where the interface becomes all important.

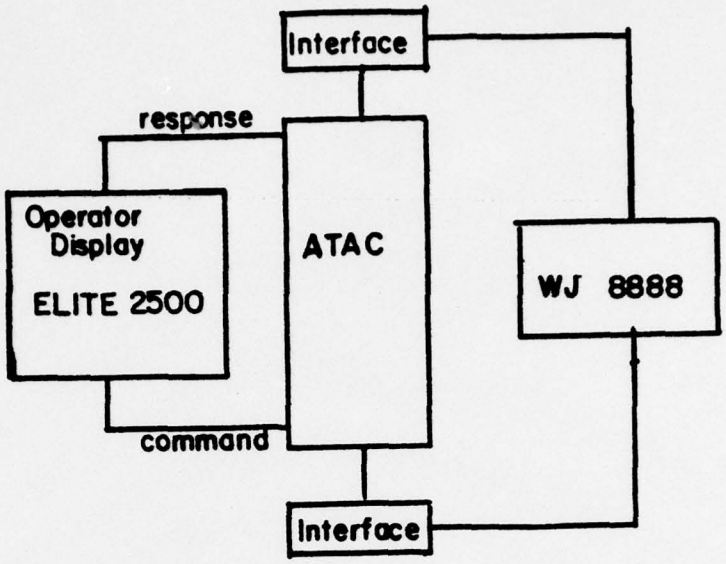
An interface is a piece of equipment placed in the data path between two devices. Its purpose is to rearrange, translate, or change the speed of this data to meet the needs of one or both devices. In other cases the interface is used to convert data from an analog to digital (A/D) or digital to analog (D/A) form, or both. Interfaces of either type range in complexity from a few integrated circuits to the use of microprocessors. Most, however, fall in between. This thesis discusses the design and construction of an interface in this middle class. Here, the computers are the Applied Technology Airborne Computer (ATAC) minicomputer and the MOS Technology Inc.'s KIM-1 microprocessor. Their goal is to program and process outputs from a digitally tunable Watkins Johnson WJ-8888.

The two computer systems arrive at their goal by

different means. The ATAC uses a closed loop with the operator (Figure 1a) while the KIM-1 excludes the operator while executing its program (Figure 1b). In the ATAC loop the operator actively controls all communication between the computer and receiver. In this way it is possible to display information from the receiver on the video display at any time except during a scan (see Chapter V). It also provides quick reference to the data to be sent, the data last sent, and latest received data. This was invaluable during debugging. From the terminal it is also possible to adjust available parameters as necessary to meet any requirement.

The KIM-1 does not directly exchange digital words with the receiver, but rather exchanges digital data for analog data. This does not provide a feedback loop that includes the operator. Once begun, the KIM-1 program selects and sends data words to the receiver and processes the analog data received until the program comes to an end or is halted by the operator. Direct information is not available to determine when or if a digital word has been sent or received correctly.

Problems encountered during the design and construction of the interface and their solutions are shown in Table I. In this instance signal level compatability was not a problem because the I/O from the receiver, the interface, and the two computers were all TTL logic levels and, therefore, matched. It is believed that these problems are a typical list that may be encountered when interfacing.



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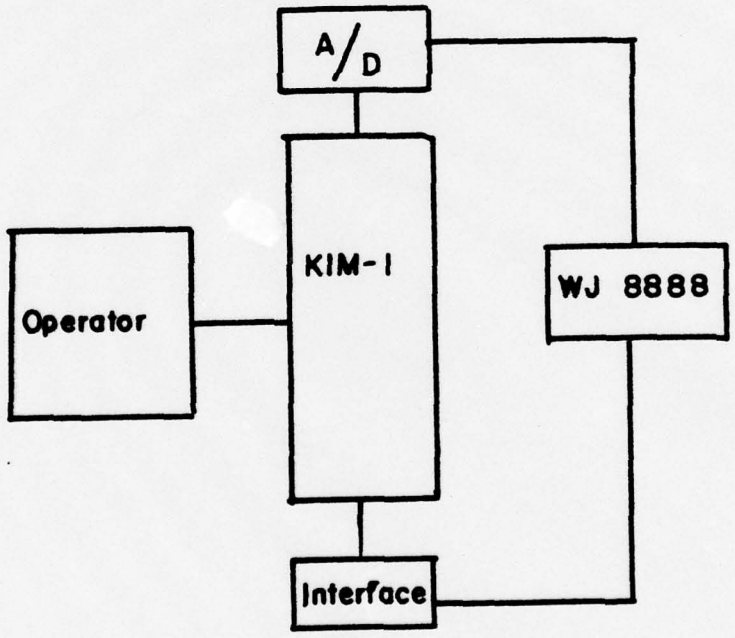

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Figure 1
Computer Control

PROBLEM	SOLUTION
1. Noise on the ATAC I/O lines.	1. Use of Schottky circuits reduced or eliminated the noise.
2. Different clock rates of the computers and the receiver, and different data word lengths.	2. ATAC; converted parallel outputs into serial form. KIM-1; used interrupt lines to slave the KIM-1 to the receiver's clock.
3. Timing	3. Identified receiver periods by the Monitor Clock output. This provided a pulse which signaled stable data.
4. Inputting data to the ATAC.	4. Open collector buffers were used to sink the required current for proper data transfer.
5. Switching between the ATAC and the KIM-1.	5. Multiplexers and buffers were used to switch between the two computers.

Table I

Problems and Solutions

II. THE RECEIVER

The Watkins Johnson WJ-8888 (WJ) is an HF receiver designed for use in the 550 kHz to 30 MHz band. Its advantages include the ability to detect and output both the AM and FM IF signals while simultaneously maintaining a separate output of eight selectable detection modes. Options available to the operator include different IF bandwidths, variable RF gain, squelch control, and a tuneable BFO frequency. The WJ is digitally controlled and uses a 64-bit word as shown in Figure 2. This word contains the information necessary to transfer the frequency, detection mode, IF bandwith, RF gain, BFO frequency, and signal strength both internally and externally.

All inputs and outputs from the receiver are controlled by the synchronous, remote I/O board. This board is a gated transfer point for all digital data exchanged with the receiver. A number of control lines are needed to provide the necessary demands on the receiver. Three balanced input pairs and four balanced output line pairs, plus a ground are provided for this purpose. All three inputs are required for remote operation. They are address (or enable), trigger, and data input. The address pair is the most important for it serves as the master "on-off" switch for the remainder of the I/O pairs. The outputs furnish the required clocks (command and monitor), output data, and a local/remote status.

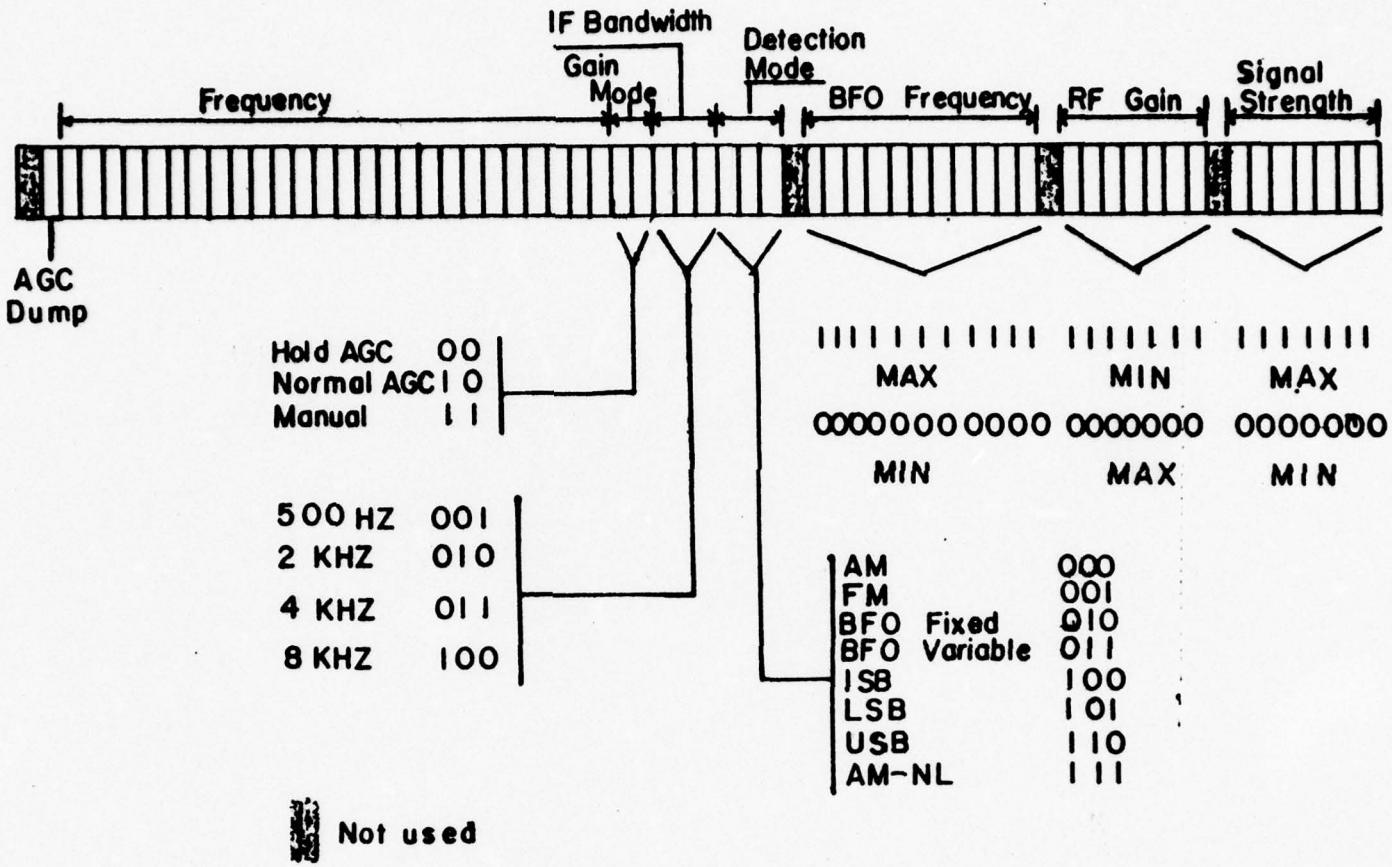

Figure 2

Receiver's Word

The Watkins Johnson operates on a sequential cycle divided into four equal periods and six identifiable modes. The periods regulate the different operations while the modes ascertain the origin of the data. Table II shows the interaction of the periods and modes of the receiver. Three of the six modes are memory read and write functions; these cannot be remotely controlled and, therefore, are of no concern here. Of the remaining three, two are the remote active and remote passive modes. These allow the introduction of externally generated data and prevent manual intervention during all but one of the four periods. Manual control is available in the remaining mode, local.

In order to manage the data word movement correctly, the receiver utilizes a common bus or data node arrangement as shown in Figure 3. This simplifies operation by forcing all data words to pass through this node in the same direction, regardless of their origin or desired destination. The multiplexer controls the input to the data node. Control of the multiplexer and, therefore, the origin of the data is managed by the internal modes of the receiver. The objective of period one is to load the receiver register. In the local and remote passive modes, the data word is shifted from the front panel register, through the multiplexer and data node, into the receiver register. The difference between these two modes is in the action of the data prior to shifting. The local mode updates the data word from the front panel storage registers during the early

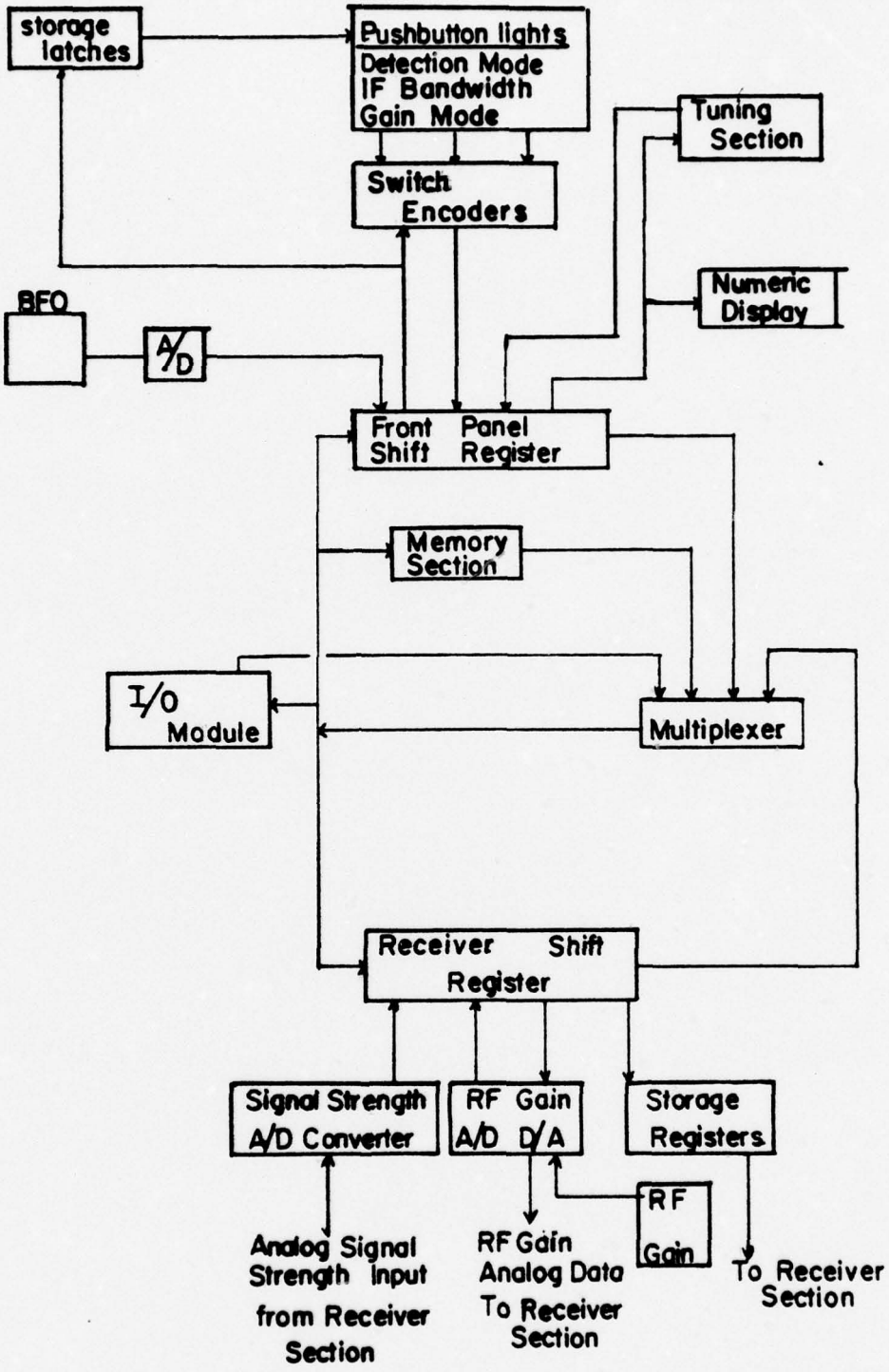

Figure 3
Block Diagram of the Digital Section

	Period 1	2	3	4
Local	Load Front Panel Reg from Front Panel/word shifted to Receiver Register	Load Rcvr Storage Reg/ Signl Strength and RF gain updated /word shifted to FrontPanel Register	Display updated no words shifted	Change to Remote Active or Remote Passive possible
Remote Passive	Word shifted from FrontPanel Register to Receiver	Update only Sig Str /Load Rcvr Storage Reg/word shifted to FrontPanel Reg.	Same as Local	Change to Lcl or Remote Active possible
Remote Active	Word shifted from I/O module to Receiver Register	Same as Remote Passive	Same as Local	Change to Remote Passive automatic. Change to Local possible

Table II

Receiver Modes and Periods

portion of period one. This action is inhibited during the remote passive mode. In the remote active mode the data word originates from a remote device, is shifted by the command clock through the remote I/O board, on to the receiver register via the multiplexer and data node.

The first part of the second period is spent loading the data shifted during period one into the receiver storage registers. During this time the signal strength is updated in the receiver register regardless of the mode. The RF gain A/D-D/A converter functions according to the selected mode. In the local mode the RF gain bits in the data word are replaced by A/D conversion of the front panel RF gain control knob. The two remote modes reverse this action and load the RF gain D/A converter with this data from the word. After this is completed, the word is shifted in all modes out of the receiver register, through the multiplexer and data node, and into the front panel register. If the address line from the remote device is active high, the data word and the monitor clock are available on their respective output line pairs.

Periods three and four inhibit movement of the data word. Period three updates the front panel pushbutton lights and numeric display. Period four is the only period in which changes in receiver mode are allowed. During this period changes from a remote mode to local, or from local directly to remote passive can only be accomplished by depressing the appropriate pushbutton on the front panel. A

change from local and remote passive to remote active is automatically done by the remote I/O board whenever both the address and trigger line pairs are active high during this period. The remote active mode immediately reverts to the remote passive mode at the beginning of the next period four. The total cycle time of the receiver is 10.24 msec (2.56 msec per period). In order to change modes successfully, it may be necessary either to hold in the pushbutton or to hold the trigger and address lines high for up to 7.68 msec (three periods). This ensures that the mode change demand occurs in period four.

All outputs are available from connectors J1, and J6 through J10 located on the back of the receiver. J1 is the digital I/O connector. The other connectors are all analog outputs. J6 is a 455 KHz IF signal of at least 20 KHz bandwidth. AM and FM detector monitors are provided at connectors J7 and J9 respectively. J8 is a predetection, 455 KHz center frequency IF output whose bandwidth is set by the front panel. A balanced and unbalanced line audio and both upper and lower sideband outputs are available from the appropriate pins at J10. The balanced line operates at all times. The unbalanced line is operable unless headphones are plugged into the front panel. The lower sideband output is active when the receiver is in either ISB or LSB detection modes, and the upper sideband output is active during ISB, USB, and CW modes.

III. THE COMPUTERS

After studying the inputs and outputs from the receiver, three choices were available for further development of the interface. It could be designed to pass the clock pulses on to the interrupt lines of the computer and, therefore, match the computer's timing to that of the receiver. Or, a buffer could be constructed to input the data serially at the clock rate of the computer and output it at the clock rate of the receiver. The third choice, also a buffering arrangement, could exchange data in parallel to the computer and serially to the receiver.

The chief factor influencing the design decision was the availability and distribution of computer control and I/O lines. For the first computer, the primary objective was to investigate the feasibility of both remotely tuning the receiver and accepting a data word in return. The requirements for the second computer, the MOS Technology Inc. KIM-1, were less strict. Its objective was to tune the receiver digitally through use of the interface. Its input, however, was to come from a A/D converter for processing.

A. THE ATAC

The ATAC was originally designed to provide EW service to aircraft. Built to do real-time analysis of signals, it has very short cycle times, optional microcode programming, and double precision arithmetic as part of the standard package. All this, combined with its large instruction set, makes the ATAC a versatile and powerful tool. Although data could be transferred serially by proper programming, the ability of the ATAC to both input and output sixteen bits in parallel on the PIO (parallel input/output) lines proved more advantageous. Any one of the ATAC's sixteen registers can input or output from these lines. In order to properly transfer this data, the PIO bus must be augmented by an address provided by the sixteen bits of the "eXtended" Arithmetic Register (XAR). Another necessary output is one that informs the external device when the ATAC is ready for the transfer. On the ATAC this function is provided by the Input/Output Demand (IOD) line. Referring to the timing diagram in Figure 4, an input command is initiated by placing an address on the XAR lines and following this address with a low on the IOD. This signifys that the ATAC register is ready for data. After approximately one microsecond, the IOD is placed high and the address is removed. During this microsecond the data for the ATAC must be stable. For an output command, the XAR and the PIO lines first present the address and data for output. When they

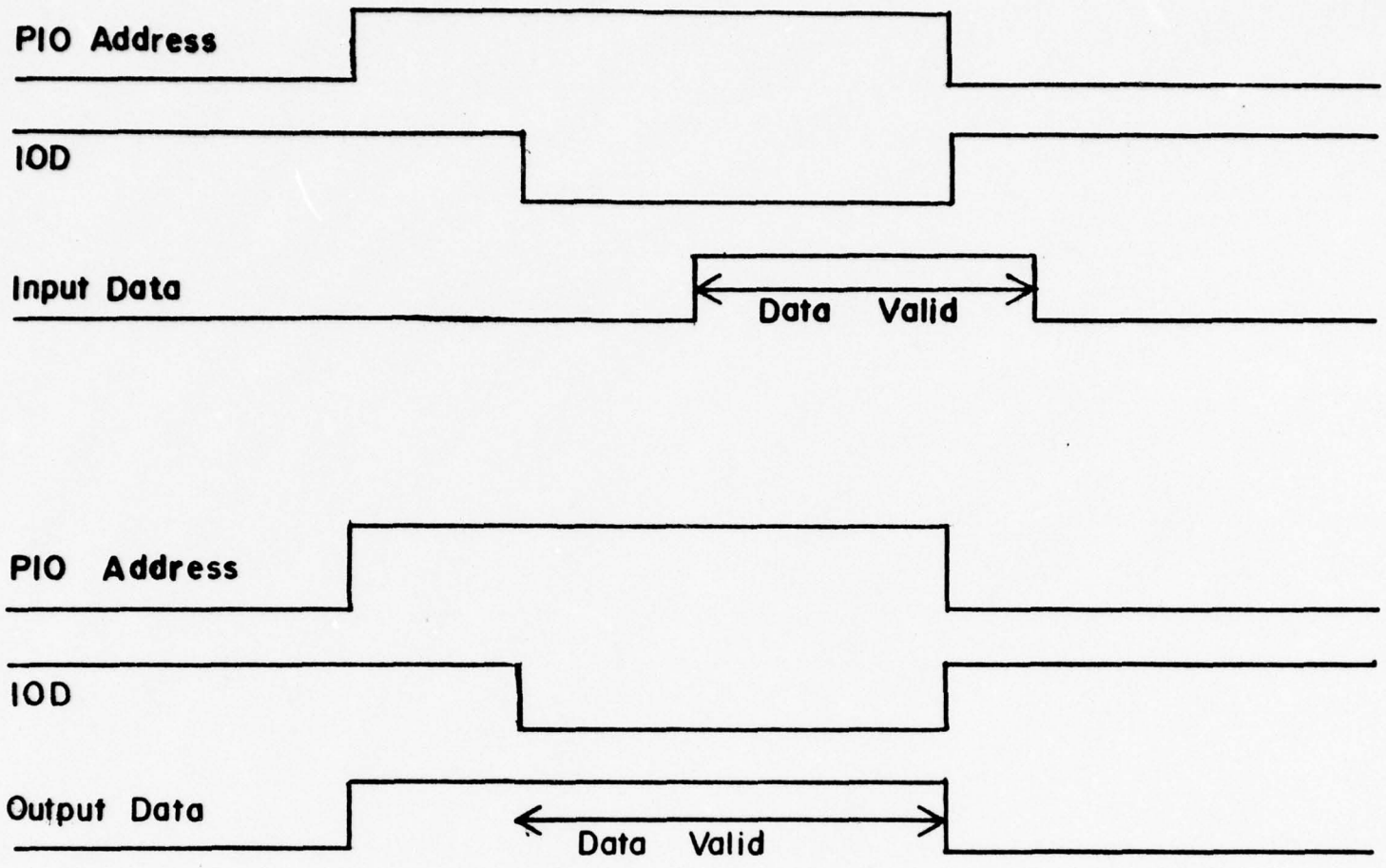

Figure 4
ATAC I/O Timing Diagram

are stable, the IOD line is set low. The data is then available for about a microsecond, as before. The IOD line is then placed high and the address and data are removed from their respective lines.

For operator interaction a serial ASCII, RS232 I/O port is also available. A Datamedia Elite 2500 television terminal is connected here to provide the operator with the necessary control and programming capablity for use of the ATAC. By proper programming and use of the XAR lines, it was possible to translate each command for the interface. Using a demultiplexer on the interface board, four of the five available XAR addresses were separated into sixteen separate commands. One of the remaining lines and the IOD line were used as strobes to identify the receiver and to signify stable data (Chapter III). This arrangement provided both the adequate isolation and flexible operation desired.

B. THE KIM-1

The KIM-1 is at the other end of the computer spectrum with respect to the ATAC. It is a microprocessor designed around the MOS Technology Inc. series MCS6500 Central Processor Unit. Complete on a single printed circuit board, the KIM-1 is simple to operate and easy to program. While its cycle time is slower than that of the ATAC, it is still much faster than the receiver and more than adequate to meet

the requirements. Since the input data came from converted analog data supplied from the receiver's FM IF output (J9) and an external A/D converter, the design for this portion of the interface was simpler.[1]

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[1]For a more detailed discussion of the KIM-1, its objectives, programs, and operating procedures, see Signal Acquisition and Sampling Using a Microprocessor, by LT. D. Rosenberger.

IV. THE INTERFACE

The interface was initially designed solely for the ATAC. A means of converting four ATAC words into one receiver word was needed first, in order to test the program, the computer, and the receiver together. The simplest and cheapest way to accomplish this conversion and still fully utilize the capabilities of the ATAC was to build a 64-bit register using eight parallel-in, serial-out, eight-bit shift registers. A control section was also necessary to properly handle this data. The ATAC XAR addresses were decoded by this control section to provide the load commands for the registers and to signal the receiver to input the word.

The next step in construction was also simple in theory. Since the computer uses the PIO lines for input as well as output, what was needed was a connection which would not interfer with the section already built. The ICs chosen to isolate the two sections are called Tri-State. These ICs have a "no output" state in addition to the normal high and low of TTL circuits. They could not, however, sink or supply enough current to drive the computer PIO bus. A solution was found by following these ICs with open collector buffers. Not only did they provide the necessary amplification, they did not degrade the isolation performance of the Tri-States. This second section also had

a 64-bit register built from the smaller shift registers. In this case, though, they were serial-in, parallel-out. In order to remove the word from the register in sixteen-bit sections, the outputs from the shift registers were connected to four-to-one multiplexers. These multiplexers were Tri-State. With the proper control it was possible to shift the word from the receiver into this register, and transfer it to the PIO bus in the correct sequence.

Increased complexity in the control section came with this implementation. A method was needed to prevent the computer from transferring a word until it had been completely shifted into the register. The period two clock output from the receiver was used as a reference to provide a pulse to inform the computer when shifting was complete. This pulse was positioned in the same time interval as period three of the receiver. The additional benefit of identifying period four was obtained. This meant that the output for the trigger line to the receiver could be shorter and still meet the requirement to occur in a portion of period four.

After completion of the testing for the ATAC, an interface was designed and constructed for the KIM-1. This design was very simple to implement, since all the necessary timing circuits were already built and tested. The two computers were kept from interferring with each other by installation of a manual switch. This switch controls the

address of a multiplexer that separates the lines in the interface common to both computers. The control section was wire-wrapped rather than placed on a printed circuit board to provide greater flexibility, easier maintenance, and to reduce cost.

A. THE CONTROL SECTION

The heart of the interface is the control section (Figures 5 and 6). The main purpose of this section is to decode and route commands from the ATAC and provide the necessary circuits to interface with the receiver. It also contains the circuits for the operation of the receiver by the KIM-1. The receiver's outputs are driven by line drivers which provide complementary TTL levels. The inputs are applied to line receivers which accept these complementary TTL levels. The interface, therefore, had to use these same receivers and drivers to be compatable with the Watkins Johnson.

The SPST switch mounted on the front of the interface case selects the computer controlling the receiver. With the switch in the ATAC position, a high is placed on pin 1 of IC-JJ and pins 1 and 10 of IC-MM. IC-JJ is now set up to transfer the following: the address and data outputs to the line drivers on IC-LL, the trigger command to pin 2 of IC-Z, and a low in line CCK7. The CCK7 line completes the

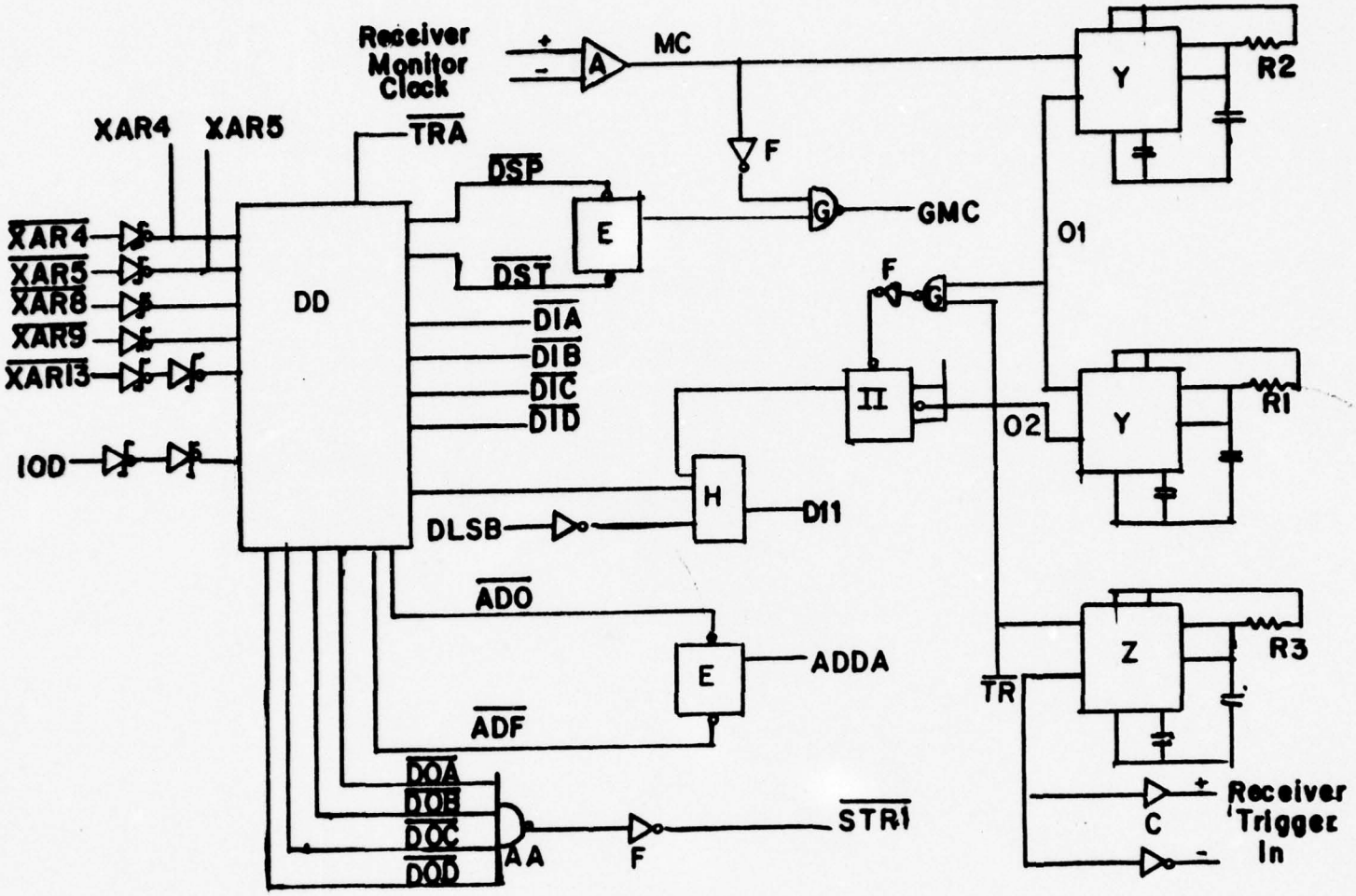


Figure 5
Interface Control Section (Part I)

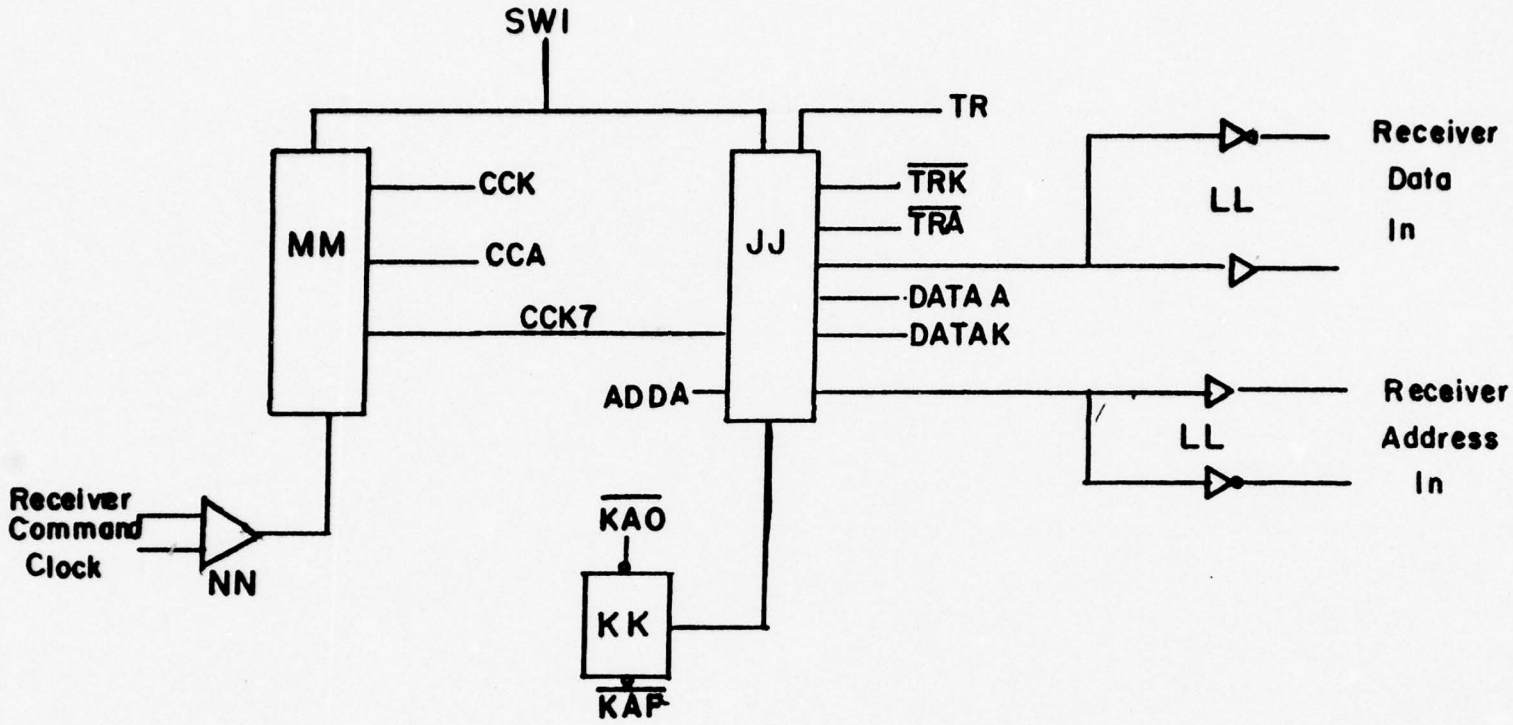


Figure 6
Interface Control Section (Part 2)

TRA	[0]	ATAC Trigger Commmand
DIA	[1]	Receiver input word one
DIB	[2]	Receiver input word two
DIC	[3]	Receiver input word three
DID	[4]	Receiver input word four
DSP	[5]	Stop Monitor Clock
DST	[6]	Start Monitor Clock
ADO	[7]	ATAC - Address on
DOA	[8]	Receiver output word one
DOB	[9]	Receiver output word two
DOB	[9]	Receiver output word two
DOC	[10]	Receiver output word three
DOD	[11]	Receiver output word four
RDY	[12]	Read D11 for ready signal
ADF	[15]	ATAC - Address off
TR		Receiver trigger
CCK		Kim-1 Command Clock
CCK7		Control Line for Kim-1 Command Clock
CCA		Command Clock for ATAC interface
ADDA		ATAC - Receiver Address
KADD		KIM-1 - Receiver Address
KAO		KIM-1 - Receiver Address On
KAF		KIM-1 - Receiver Address Off
TRK		KIM-1 Trigger Command

(Numbers in brackets refer to ATAC XAR commands)

Table III

Interface Command List

commands to IC-MM. This IC is a quad Tri-State buffer which is used to control the destination of the command clock. The switch opens buffer one which directs the command clock to the ATAC. The CCK7 line closes buffers two and four disabling the command clock input to the KIM-1.

The ATAC supplies the control section with six lines. Five of these are the XAR bits 4,5,8,9, and 13. Using 4, 5, 8, and 9 as address lines to pins 20-23 of IC-DD, a four-to-sixteen demultiplexer, sixteen (2^4) unique commands (Table III) were made available. The sixth line, the IOD, and XAR 13 were used as strobes or enables for the demultiplexer. In this way XAR 13 was able to specify this receiver uniquely, and the IOD ensured that addresses and data were stable before passing a command. When both IOD and XAR 13 are low, IC-DD is operational and the output corresponding to the address on pins 20-23 is forced low. At any time that either or both the two strobe lines are high, all outputs of IC-DD are held high and no commands are generated, regardless of the activity on pins 20-23.

At the beginning of the Receiver Control program (Chapter IV), the ATAC sends commands to address the receiver (ADD) and to open the gate for the monitor clock (DST). ADD places a low on pin 2 of IC-E, setting the flip-flop and forcing the ADDA line high. This line activates the receiver's I/O through ICs -JJ, -A, -B, -C, and -LL, as described above. The DST command is passed to

pin 7 of IC-E. This sets this flip-flop and allows the monitor clock (MC) to shift data from the receiver into the storage register during every period two of the receiver's cycle. The MC line is also connected directly to a timing circuit. This circuit produces the pulse described in the early part of this chapter. The first of a pair of monostable multivibrators, IC-Y (Figure 5) is triggered by the first clock pulse of MC. IC-Y outputs a pulse, interval A of timing diagram (Figure 7), which triggers the second. The second's output, interval B, is connected to pin 1 of IC-II, a negative-edge triggered, J-K flip-flop. This IC is wired so that it is set on the output of the second multivibrator and reset by either the the output of the first multivibrator or the command TR. The output of this flip-flop, pin 15, is called the RLP. This line is multiplexed with the least significant bit of the output register and inverted by IC-H for use by the ATAC on line D11.

The RLP pulse is adjustable through variable resistors (trimmers) one and two. Trimmer one controls interval B and trimmer two interval A. In effect, trimmer two varies the position of the pulse and trimmer one its width. The placement and width are the key to proper operation of the interface. The pulse must remain in period three. Although some overlap into period four is allowable it is not desirable, and any overlap into period two could cause

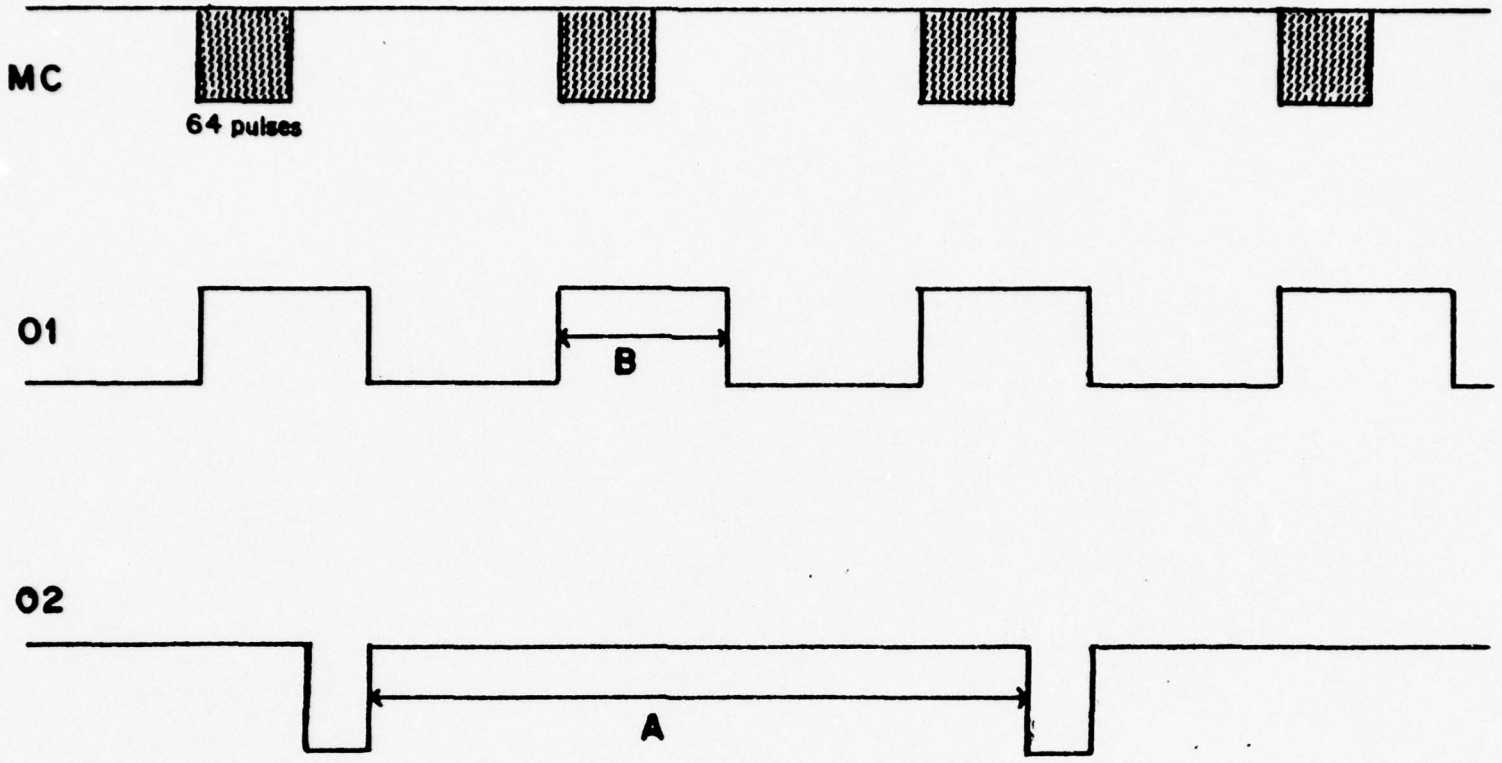


Figure 7
Interface Timing Diagram

incorrect operation. At present, the RLP pulse is programmed for every other period three. This allows the receiver to stabilize between samples taken by the computer. If more or less time is desired, the pulse can be set in every, every other, or every third period three by varying trimmer one. Greater time between pulses can be achieved by changing the .47 uF capacitor (nH-7,8) to one of larger value.

When the ATAC is ready to send a word, it loads the input register of the interface using commands DIA, DIB, DIC, DID, and then waits for a high on the D11 line. When RLP is low, D11 is high and the ATAC sends command IRA. This command is routed to a separate monostable multivibrator, IC-Z, by way of multiplexer IC-JJ. The timing circuit provides the trigger pulse in period four which changes the receiver's mode to remote active. It also sets RLP high to prevent any interaction with the ATAC until this cycle of the receiver is complete. During the following period one, the receiver sends the command clock to the input register via ICs -JJ and -MM, and inputs the data word through ICs -JJ and -LL. Meanwhile, the ATAC is waiting for RLP to go low again. When it does, the ATAC closes the MC gate with a DSP command and loads four sixteen-bit words with commands DOA, DOB, DOC, and DOD. Once the receiver word is stored in the ATAC, a DSTA command is sent to open the MC gate. When the operator has finished excution of the Receiver Control program and exits, the ATAC

sends the interface commands ADF and DSP to turn off the address line to the receiver and close the MC gate. The interface is now back in a stand-by status.

In order to set up the interface for operation with the KIM-1, the reset button must be pushed and the computer switch placed in the KIM-1 position. The reset button is unique to KIM-1 interface operation, and is necessary because of the use of the KIM-1's non-maskable interrupt. This interrupt is used to synchronize the KIM-1 with the receiver's command clock. Pressing the reset button places a momentary low on pin 5 of IC-KK, the flip-flop that controls the receiver's address line from the KIM-1. This resets the flip-flop and insures that the command clock output is disabled until required. ICs -JJ and -MM now transfer data from the KIM-1 and not the AIAC. The CCK7 line follows the address line from IC KK and gates the command clock off and on at the proper time. When the KIM-1 is ready to send a word to the receiver, it waits for a low on the RLP line. This line is connected to the maskable interrupt line. This low generates an interrupt and places the KIM-1 in the output program. This routine provides a trigger pulse for the trigger timing circuit and outputs the data synchronously with the command clock. The difference between the AIAC and KIM-1 actions of the interface is due to the position of the switch. The only function the interface serves is to provide reliable and compatible data to the appropriate device, whether it is receiver or

computer.

b. INPUT/OUTPUT REGISTERS

These two registers are used for the ATAC only. The registers were designated input or output by their related function with the receiver. They were constructed to provide the necessary, temporary storage while converting parallel and serial data back and forth. Both registers are connected to the PIO bus, with the major difference being the Tri-State connections of the serial to parallel, or output register.

The input register (Figure 8) was the easier to implement. It consists of eight 8-bit shift registers with parallel input and serial output. The parallel input comes from the ATAC's PIO bus, which is buffered by schottky inverters to reduce noise. The lines are connected to the ICs in such a way as to load words into two adjacent shift registers simultaneously. This is possible because the shift registers will only latch data in when their respective load line is low. By proper connection of the DIA-DID lines to pin 1 of the ICs, and coordinating the commands with the data, the output register can be completely and correctly filled. The command clock from the receiver is connected to pin 15 of each of the eight registers. When it is present, it clocks the data through the register exiting through pin 16 of IC-VV. From here, it goes through the control section

at IC-MM and on to the receiver.

The output register (Figure 9) performs the reverse operation. However, in order to separate it into words that are short enough for the ATAC, the data has to be multiplexed before it can be connected to the PIO bus. The Tri-State multiplexers, ICs -I through -L and -U through -X, and the required buffers, ICs -FE through -GG, were used to prevent interaction with the PIO bus when not in use. The timing here is more critical than in the input register system. Before the ATAC begins a read cycle from the output register, the clock signal to the register is stopped (DSP). This prevents the ATAC from reading non-stationary data. All the Tri-State multiplexers are addressed by connecting XAR bits 4 and 5 to pins 2 and 4 respectively. The commands DOA-DOD are ANDed together (NANDed and inverted) and the output connected to all the multiplexers as strobes at pins 1 and 15. When the ATAC reads a word, the XAR bits select the word and the strobe produces it during the microsecond when the PIO bus is available.

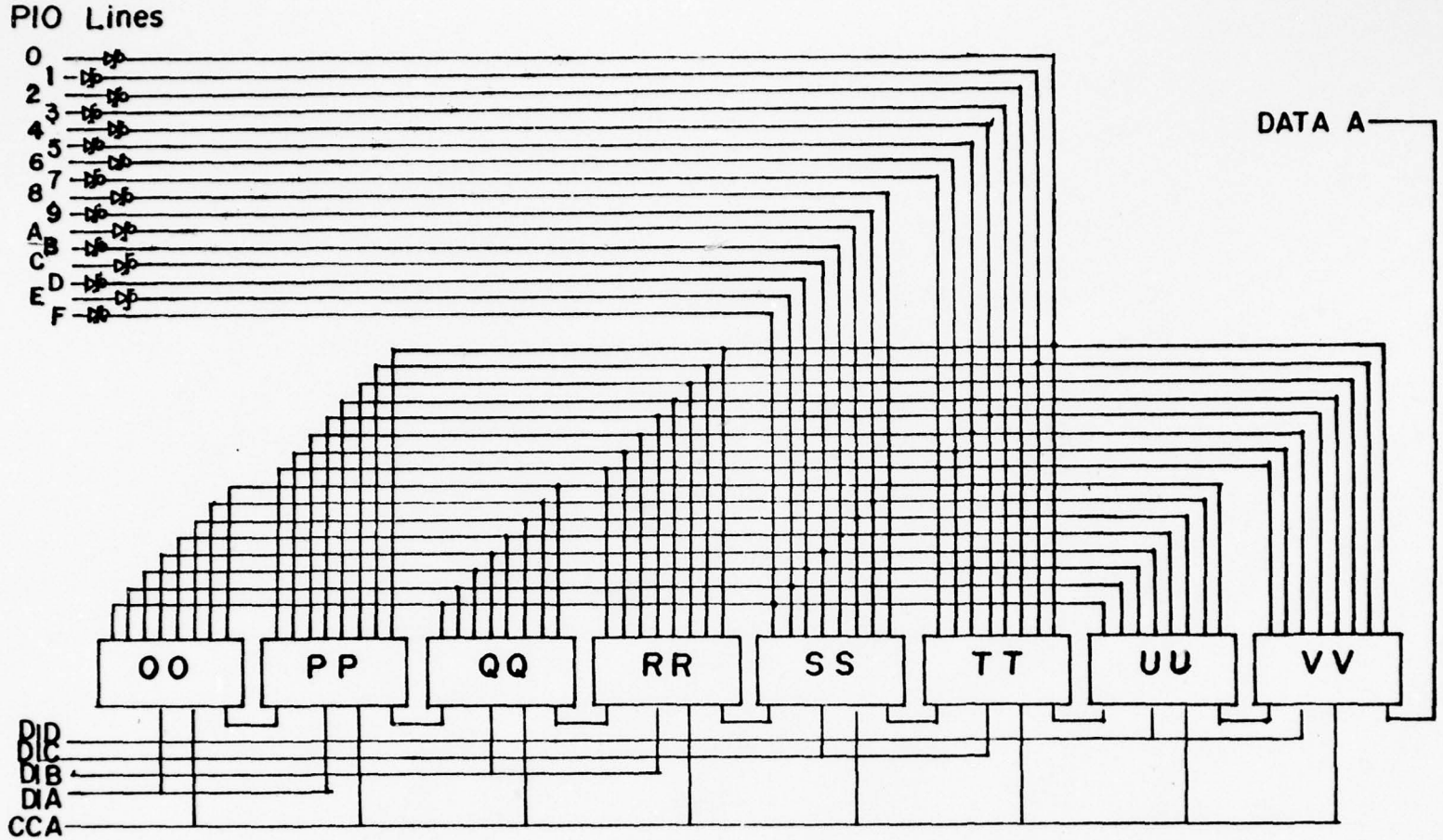


Figure 8
Input Register

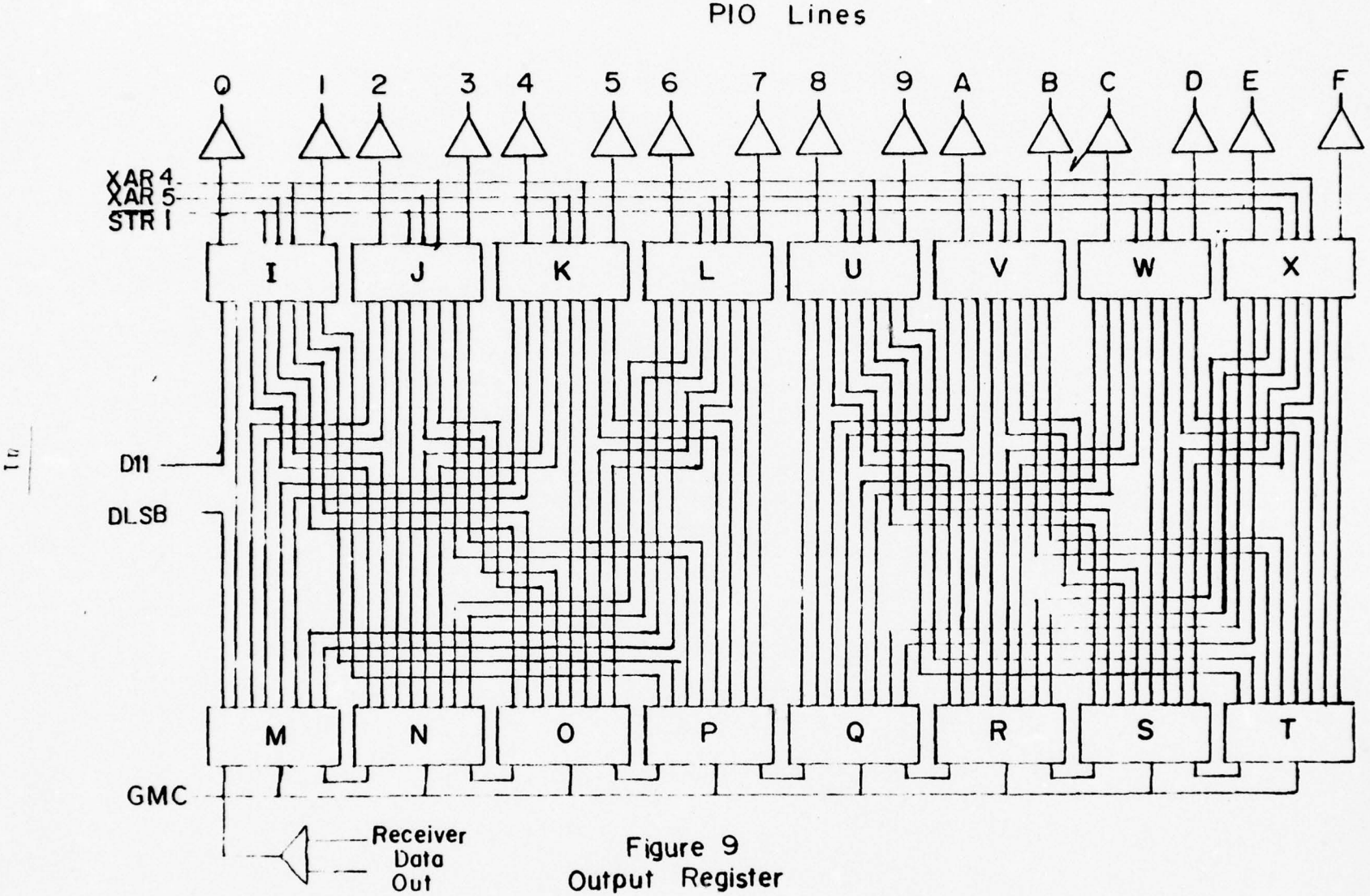


Figure 9
Output Register

V. THE PROGRAM

The ATAC program was written in two major sections; a system monitor and a control. The monitor is called the Main System and provides the operator the ability to program the ATAC from the operator's terminal. Receiver Control commands the interface and, therefore the receiver. Both programs were initially written prior to the construction of the interface, so many modifications were made using the Main System and its subroutines. After the interface was built and tested and the Receiver Control section modified to correctly contol the tuning of the receiver, the complete program was saved on paper tape (Appendix C). Operation of the computer is discussed in Appendix B and a sample run can be found in Appendix E.

A. THE MAIN SYSTEM

The Main System section consists of a small executive and a group of interconnected subroutines (Figure 10). The executive provides a basis for the subroutines when the receiver control program is not being executed. It is these subroutines that control the input and output to the operator terminal. The input routine is called KEYMR and the output routine, OUTPUT. OUTPUT converts correctly-formatted computer words into ASCII and displays them on the

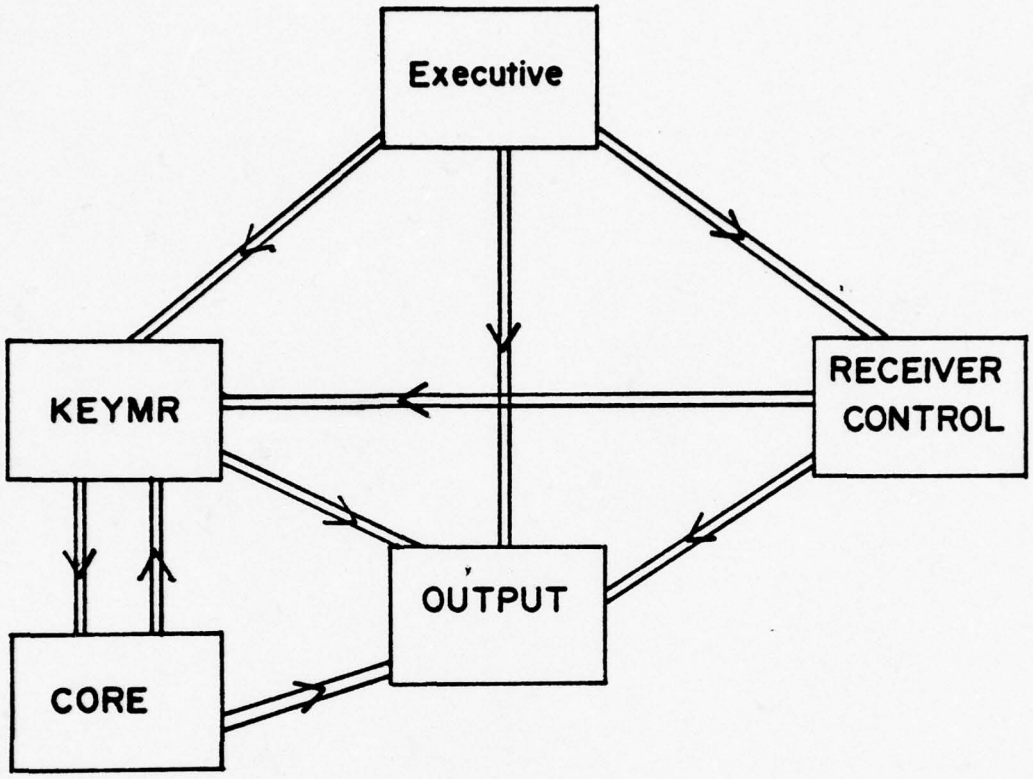


Figure 10

ATAC Program Block Diagram

I. CORE Commands

CO -- calls CORE from KEYMR.

a. DU 'address' -- displays 80 memory locations beginning with 'address'.

b. DI 'address' -- displays the contents of memory location 'address'.

c. CH 'address' 'value' -- Replaces the contents of memory at 'address' with 'value'.

d. CS 'address' -- Beginning at 'address', the contents of memory are replaced with the values typed on the lines following the command. Exit is accomplished by command DD.

e. DD -- Returns execution to CORE if in CS, otherwise returns to calling routine.

II. Receiver Control Commands

WJ -- Calls Receiver Control from the executive.

a. 0 -- Set-up - Routine to input values for entry into Receiver.

b. 1 -- Displays set-up control word.

c. 2 -- Displays last control word sent to receiver.

d. 3 -- Displays last control received from receiver.

e. 4 -- Sends set-up control word to receiver.

f. 5 -- Routine to input scan variables and execute a scan.

g. 6 -- Receive and Display control word from the receiver.

h. 7 -- Exit program and return to caller.

i. 8 -- Reinitialize program as if entering.

Table IV
AIAC Program Commands

terminal. KEYMR does the reverse, and stores the input in a buffer for use by the caller. KEYMR and OUTPUT were programmed to accept and display only uppercase letters, numerals, and a small number of needed symbols. But, because of the method employed to convert ASCII to machine code, it was found that each lower case letter entered from the keyboard was automatically mapped into its respective upper case twin. This relieves the operator of the responsibility of using the shift key. A part of the KEYMR, called CORE, is available for use by the operator to display and/or change sections of memory. The four available commands in this routine and their functions are displayed in Table IV. Care must be taken not to change memory locations which are used by the Main System. This could result in complete erasure of the ATAC's memory. Without KEYMR, OUTPUT, and CORE, or routines similiar to them, it would have been extremely difficult to perform any amount of troubleshooting or modification of the Receiver Control section.

B. RECEIVER CONTROL

This section of the system is a branch of the executive. Its main objective is to control both outputs and inputs of the interface from the operator's terminal. To assist those operators with little experience in this system, the Receiver Control section is equipped with uncomplicated

instructions and program safeguards. This produces almost foolproof operation but, it does so at the expense of program simplicity. Discussion of this section is separated into two parts. First a broad description of the complete section is discussed, followed by a detailed look at the two subroutines which interact with the interface.

When the Receiver Control program is entered, it performs five important actions. It initializes all necessary flags; enables the receiver and opens the MC gate; sends and receives a complete receiver word; and displays the instruction set to the operator. After this, it calls on KEYWD and waits for a command. When an input is delivered, the program checks its legality. If it is not a valid command, KEYWD is called again.

A valid command is a numeral between zero and eight (Table IV). These can be separated for discussion into three groups. The display group (0-3) inputs and exchanges information with the operator. The receiver group (4-6) performs operations with the receiver. The final group of commands (7-8) are used to exit or reinitialize the program. Group one has one input and three display commands. Command zero instructs the operator to input the parameters desired. It stores these parameters in memory in the display format, as opposed to control word format. Commands one, two, and three all display parameters. One displays the last parameters set-up by command zero. Two displays the last parameters sent to the receiver. Three displays the last

word received from the receiver. Commands seven and eight make up group three. Seven exits the program entirely and returns to the executive after disabling the receiver. Eight, on the other hand, returns the program to its beginning as if it had just been entered.

The remaining three commands are the most important. Group two commands control the actions of the interface. Command four converts the parameters set-up by command zero into control word format. It then calls the I/O subroutine described below, and outputs and inputs a receiver word. To merely receive a word from the receiver, command six is used. The program calls the input subroutine below and then exits to command three to display the parameters received. Command five scans a band of frequencies selected by the operator in search of a specified signal strength. All other parameters remain the same as those set-up by command zero.

With the exception of the instructions executed when entering and exiting Receiver Control, complete control of the interface and the receiver is resident in approximately forty computer instructions. These forty are grouped into the two subroutines WJR and WJS. WJS sends words to the receiver and WJR receives them. WJS loads the information and addresses to be sent to the receiver into the computer registers. The addresses are then matched to a word of data and sent to the interface input register. The routine now waits for the appropriate signal generated by RLP. When

this is received, a trigger command is sent to load the word into the receiver. At this point the routine checks the value of a counter. This test is to prevent the computer entering an infinite loop if either the interface or receiver is not turned on. If the test is unsatisfactory, the routine prints:

```
INFINITE LOOP
PLEASE CHECK RECEIVER AND INTERFACE
```

and reverts to operator control. If the test is satisfactory, the subroutine automatically continues to WJR. WJR loads another set of addresses into the computer registers. Here, a short wait for the RLP signal is necessary before any action is taken. The MC gate is closed immediately upon receipt of this signal. The receiver word is then loaded into the ATAC by outputting the address on the XAP lines and reading the data on the PIO lines. When the complete word is received, the MC gate is opened. At this point it is necessary to test for command six. This test determines whether the computer is sending and receiving or only receiving. If the execution of both WJS and WJR is being performed, a comparison between the word sent and the word received is necessary. This comparison is skipped if the computer is only executing WJR (command six). The first three control words sent by WJS and received by WJR are used for this comparison, when it is performed. If

any words differ, the computer returns to WJS to repeat the cycle until one of two conditions are met: either the words match or the WJS counter test discussed earlier fails. If the words match, WJP continues on to convert the received control words into the display format and then returns to the caller.

VI. RECOMMENDATIONS

The system as it stands now is but a beginning. Additions and modifications for future work should include; A/D converters for the receiver outputs; Morse and/or teletype decoders; and an expansion of the computer program. Implementation of either of the first two implies the third. There are some operator assistance program modifications that need to be made. The two that come immediately to mind are (1) a method to abort the scan routine from the operator's console, and (2) the ability to change individual parameters in addition to the set-up command already located in the program. Addition of the A/D converters implies a program increase to decode and process this new data. Switching routines and probably some hardware will be needed for the decoders. The capabilities of the system are limited only by the abilities of the operator and programmer.

VII. CONCLUSION

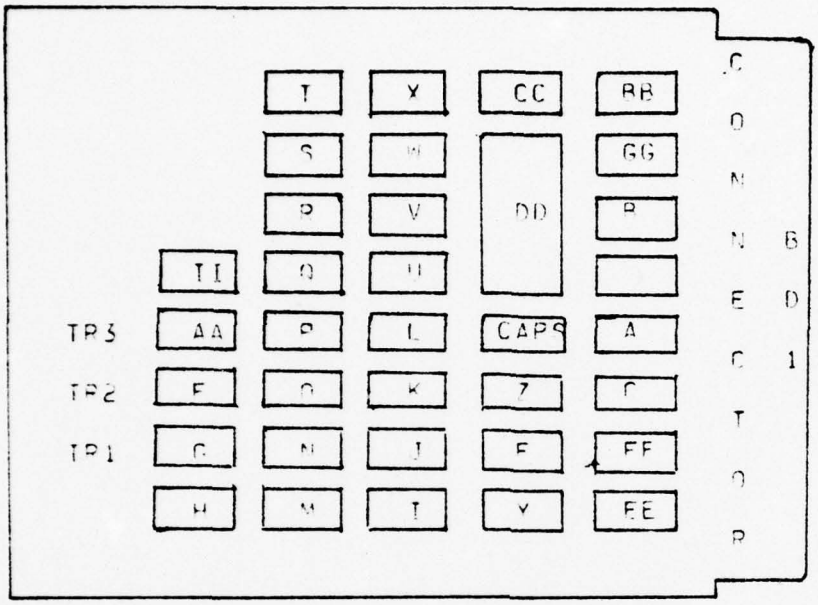
As long as the computer requires only that data obtained from the receiver's word, the interface is flexible enough to provide reliable results. At this time there are no known "bugs" in either the interface or the program. Both have been thoroughly tested to provide the operator with the most dependable system possible.

APPENDIX A

INTERFACE WIRING

A. Board 1

Integrated circuit locations (from Top of board).



Integrated Circuit

pin	A 8820	B 8820	C 8830	F 7476	F 7404	G 7400	H 74157
1	BD1-M	BD1-K	C-2/Z-3	VCC	M-3	BD2-E	DD-14
2	nc	nc	C-1/C-3	DD-8	H-3	Y-9	II-14
3	BD1-L	BD1-J	C-2/C-4	DD-15	A-6/Y-8	F-11	F-2
4	nc	nc	C-3	VCC	G-5	E-11	I-6
5	nc	nc	BD1-F	VCC	AA-6	F-4	nc
6	F-3/Y-8	M-1	BD1-H	VCC	G-12	F-9	nc
7	GRD	GRD	GRD	DD-7	GRD	GRD	GRD
8	nc	nc	nc	DD-6	T-8	nc	nc
9	nc	nc	nc	VCC	G-6	nc	nc
10	nc	nc	nc	nc	II-3	nc	nc
11	nc	nc	nc	G-4	G-3	F-13	nc
12	nc	nc	nc	VCC	I-15	F-6	nc
13	nc	nc	nc	GRD	G-11	DD-14	GRD
14	VCC	VCC	VCC	nc	VCC	VCC	VCC
15	xxxxxxx	xxxxxxx	xxxxxxx	BD1-Y	xxxxxxx	xxxxxxx	xxxxxxx
16	xxxxxxx	xxxxxxx	xxxxxxx	VCC	xxxxxxx	xxxxxxx	xxxxxxx

Integrated Circuit

pin	I 7214	J 7214	K 7214	L 7214	M 74164	N 74164
1	X-15	I-15/J15	J-15/K15	K-15/L15	B-6/M-2	M-13/N-2
2	DD22/J-2	I-2/K-2	J-2/L-2	K-2/U-2	M-1	N-1
3	S-3	S-5	S-10	S-12	F-1	U-6
4	Q-3	Q-5	Q-10	Q-12	I-10	U-10
5	O-3	O-5	O-10	U-12	J-6	V-6
6	H-4	M-5	M-10	M-12	J-10	V-10
7	EE-1	EE-5	EE-11	FF-1	GRD	GRD
8	GRD	GRD	GRD	GRD	N-8	M-8/O-8
9	EE-3	EE-9	EE-13	FF-3	VCC	VCC
10	M-4	M-6	M-11	M-13	K-6	W-6
11	O-4	O-6	O-11	O-13	K-10	W-10
12	Q-4	Q-6	Q-11	Q-13	L-6	X-6
13	S-4	S-6	S-11	S-13	L-10	X-10
14	DD23/J14	K-14/I14	J-14/L14	K-14/U14	VCC	VCC
15	F-12/J-1	J-1/K-1	K-1/L-1	L-1/U-1	XXXXXXXX	YXXXXXXX
16	VCC	VCC	VCC	VCC	XXXXXXXX	YXXXXXXX

pin	O 74164	P 74164	Q 74164	R 74164	S 74164	T 74164
1	N-13/O-2	O-13/P-2	P-13/Q-2	Q-13/R-2	R-13/S-2	S-13/T-2
2	O-1	P-1	Q-1	R-1	S-1	T-1
3	T-5	U-5	T-4	U-4	T-3	U-3
4	T-11	U-11	T-12	U-12	T-13	U-13
5	J-5	V-11	J-4	V-4	J-3	V-3
6	J-11	V-11	J-12	V-12	J-13	V-13
7	GRD	GRD	GRD	GRD	GRD	GRD
8	N-8/P-8	O-8/Q-8	P-8/R-8	Q-8/S-8	R-8/T-8	S-8/F-8
9	VCC	VCC	VCC	VCC	VCC	VCC
10	K-5	W-5	K-4	W-4	K-3	W-3
11	K-11	W-11	K-12	W-12	K-13	W-13
12	L-5	X-5	L-4	X-4	L-3	X-3
13	L-11	X-11	L-12	X-12	L-13	X-13
14	VCC	VCC	VCC	VCC	VCC	VCC

Integrated Circuit

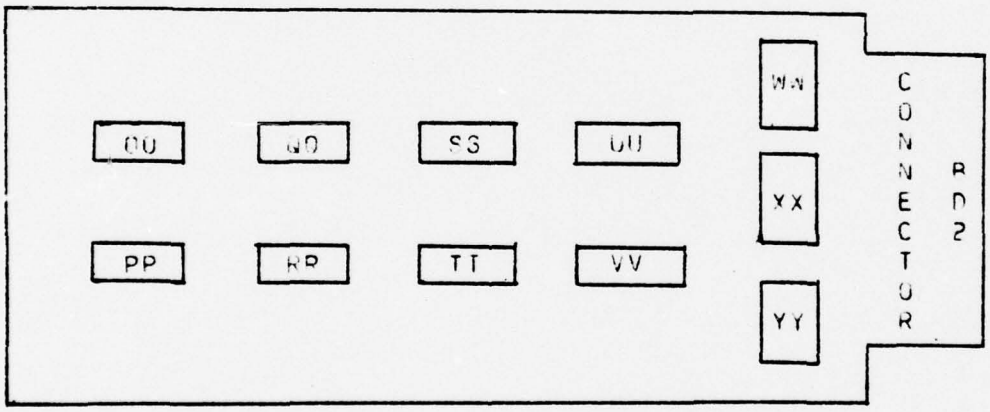
pin	U 7214	V 7214	W 7214	X 7214	Y 556	Z 555
1	L-15/U15	U-15/V15	V-15/W15	W-15/X15	Y2/Tr-1A	GRD
2	L-2/V-2	U-2/W-2	V-2/X-2	W-2	Y-1/HH-6	PD1-E
3	T-3	T-5	T-10	T-12	HH-5	C-1
4	R-3	R-5	R-10	R-12	VCC	VCC
5	P-3	P-5	P-10	P-12	BD1C/II1	HH-1
6	N-3	N-5	N-10	N-12	Y-9	HH-2/Z-7
7	FF-5	FF-11	GG-1	GG-5	GRD	Z6/Tr-3A
8	GRD	GRD	GRD	GRD	A-6/F-3	VCC
9	FF-9	FF-13	GG-3	GG-9	Y-6	XXXXXXXX
10	N-4	N-6	N-11	N-13	VCC	XXXXXXXX
11	P-4	P-6	P-11	P-13	HH-4	XXXXXXXX
12	R-4	R-6	R-11	R-13	Y-13/HH4	XXXXXXXX
13	T-4	T-6	T-11	T-13	Y12/Tr2A	XXXXXXXX
14	L-14/V14	U-14/W14	V-14/X14	W-14	VCC	XXXXXXXX
15	U-1/V-1	V-1/W-1	W-1/X-1	X-1/1-1	XXXXXXXX	XXXXXXXX
16	VCC	VCC	VCC	VCC	XXXXXXXX	XXXXXXXX

pin	AA 7420	BB 74s04	CC 74s04	EE 7407	FF 7407	GG 7407	HH CAPS	II 7476
1	DD-10	CC-6	BD1-17	J-7	L-7	W-7	Z-5	Y-5
2	DD-11	DD-18	DD-23	BD1-1	BD1-7	BD1-13	Z-6	VCC
3	nc	BD1-21	nc	J-9	L-9	W-9	Y-11	F-10
4	DD-9	BB-5	nc	BD1-2	BD1-8	BD1-14	Y-12	VCC
5	DD-13	BB-4	BD1-I	J-7	U-7	X-7	Y-3	nc
6	F-5	DD-19	BB-1	BD1-3	BD1-9	BD1-15	nc	nc
7	GRD	GRD	GRD	GRD	GRD	GRD	Y-2	nc
8	nc	DD-20	nc	BD1-4	BD1-10	BD1-16	GRD	nc
9	nc	BD1-20	nc	J-9	D-9	X-9	GRD	nc
10	nc	DD-21	nc	BD1-5	BD1-11	nc	GRD	nc
11	nc	BD1-19	nc	K-7	V-7	nc	GRD	nc
12	nc	DD-22	nc	BD1-6	BD1-12	nc	GRD	nc
13	nc	BD1-18	nc	K-9	V-9	nc	GRD	GRD
14	VCC	VCC	VCC	VCC	VCC	VCC	GPD	H-2
15	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	nc
16	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	GRD

Integrated Circuit

		DD 74154	
pin		pin	
1	BD1-P	13	AA-5
2	BD1-X	14	G-13/H-1
3	BD1-W	15	nc
4	BD1-V	16	nc
5	BD1-U	17	E-3
6	E-8	18	BB-2
7	E-7	19	BB-6
8	E-2	20	BB-8
9	AA-4	21	BB-10
10	AA-1	22	BB-12/I-2
11	AA-2	23	CC-2/I-14
12	GRD	24	VCC

II. Board 2
Integrated Circuit locations (from Top of board)



Integrated Circuit

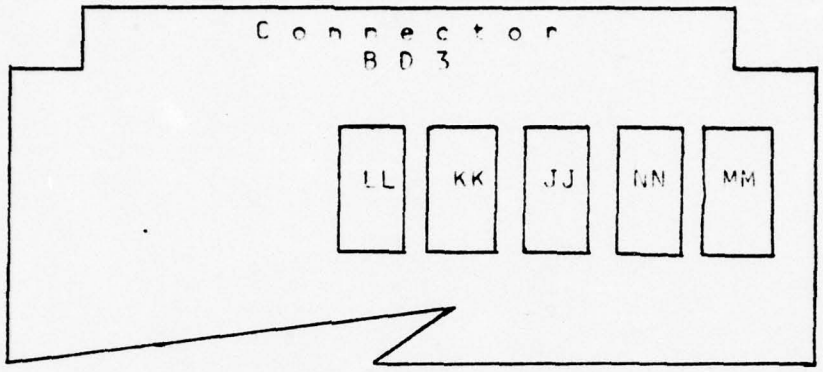
pin	OO 74165	PP 74165	QQ 74165	RR 74165	SS 74165	TT 74165
1	BD2-A	BD2-A	BD2-B	BD2-B	BD2-C	BD2-C
2	GRD	GRD	GRD	GRD	GRD	GRD
3	WW-2	YY-6	WW-2	YY-6	WW-2	YY-6
4	WW-12	YY-4	WW-12	YY-4	WW-12	YY-4
5	WW-4	YY-2	WW-4	YY-2	WW-4	YY-2
6	WW-10	YY-10	WW-10	YY-10	WW-10	YY-10
7	nc	nc	nc	nc	nc	nc
8	GRD	GRD	GRD	GRD	GRD	GRD
9	PP-10	QQ-10	PP-10	SS-10	TT-10	UU-10
10	VCC	QQ-9	PP-9	QQ-9	RR-9	SS-9
11	XX-2	XX-4	XX-2	XX-4	XX-2	XX-4
12	XX-12	YX-6	XX-12	XX-6	XX-12	XX-6
13	WW-8	XX-8	WW-8	XX-8	WW-8	XX-8
14	WW-6	YY-12	WW-6	YY-12	WW-6	YY-12
15	BD2-21	BD2-21	BD2-21	BD2-21	BD2-21	BD2-21
16	VCC	VCC	VCC	VCC	VCC	VCC

pin	UU 74165	VV 74165	MM 74s04	XX 74s04	YY 74s04
1	BD2-D	BD2-D	BD2-17	BD2-10	BD2-4
2	GRD	GRD	OO-3 *	OO-11 *	PP-5 *
3	WW-2	YY-6	BD2-15	BD2-9	BD2-3
4	WW-12	YY-4	OO-5 *	PP-11 *	PP-4 *
5	WW-4	YY-2	BD2-13	BD2-8	BD2-2
6	WW-10	YY-10	OO-14 *	PP-12 *	PP-3 *
7	nc	nc	GRD	GRD	GRD
8	GRD	GRD	OO-13 *	PP-13 *	nc
9	VV-10	BD2-K	BD2-12	BD2-7	nc
10	TT-9	UU-9	OO-6 *	nc	PP-6 *
11	XX-2	XX-4	BD3-14	nc	BD2-5
12	XX-12	XX-6	OO-4 *	OO-12 *	PP-14 *
13	WW-8	XX-8	BD2-16	BD2-11	BD2-6
14	WW-6	YY-12	VCC	VCC	VCC
15	BD2-21	BD2-21	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX
16	VCC	VCC	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX

* - bus connection - only first connection shown

C. Board Three

Integrated circuit locations (from Top of board)



Integrated Circuit

pin	JJ 74157	KK 7476	LL 8830	MM 74126	NN 8820
1	BD3-1	VCC	LL-2/JJ-7	BD3-1	BD3-5
2	KK-15	BD3-11	LL-1/LL-3	BD3-17	nc
3	BD3-6	BD3-12/20	LL-2/LL-4	BD3-16	BD3-4
4	LL-10	nc	LL-3	JJ-12	nc
5	BD3-8	VCC	BD3-7	GRD	nc
6	BD3-9	nc	BD3-10	BD3-16	MM-9
7	LL-1	nc	GRD	GRD	GRD
8	GRD	nc	BD3-19	BD3-2	nc
9	BD3-13	nc	BD3-18	NN-8	nc
10	BD3-14	nc	LL11/JJ-4	BD3-1	nc
11	nc 5	nc	LL12/LL10	BD3-3	nc
12	MM13/MM-4	nc	LL13/LL11	MM-9	nc
13	GRD	GRD	LL-12	JJ-12	nc
14	KK-15	nc	VCC	VCC	VCC
15	GRD	JJ-2/JJ14	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx
16	VCC	nc	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx

D. Connectors

Circuit Board Edge-connectors

	BD1	BD2	BD3
1	EE-2/BD2-10/CN1-2	GRD	SW1/JJ-1/MM-10
2	EE-4/BD2-11/CN1-3	YY-5/BD1-13	MM-8/BD2-21
3	EE-6/BD2-12/CN1-4	YY-3/BD1-14	MM-11/CN3-1
4	EE-8/BD2-13/CN1-5	YY-1/BD1-15	NN-2/CN2-2
5	EE10/BD2-17/CN1-6	YY-11/BD1-16	NN-1/CN2-3
6	EE12/BD2-16/CN1-7	YY-13/BD1-12	JJ-3/BD1-Y
7	FF-2/BD2-15/CN1-8	XX-9/BD1-11	LL-5/CN2-10
8	FF-4/BD2-14/CN1-9	XX-5/BD1-10	JJ-5/CN3-2
9	FF-6/BD2-9/CN1-10	XX-3/BD1-8	JJ-6/BD2-K
10	FF-8/BD2-8/CN1-11	XX-1/BD1-1	LL-6/CN2-11
11	FF10/BD2-7/CN1-12	XX-13/BD1-2	KK-2/CN3-3
12	FF12/BD2-6/CN1-13	WW-9/BD1-3	KK-3/CN3-4
13	GG-2/BD2-2/CN1-25	WW-5/BD1-4	JJ-9/BD1-F
14	GG-4/BD2-3/CN1-24	WW-11/BD1-8	JJ-10/BD1-P
15	GG-6/BD2-4/CN1-23	WW-3/BD1-7	JJ-11/CN3-5
16	GG-8/BD2-5/CN1-22	WW-13/BD1-6	nc
17	CC-1/CN1-11	WW-1/BD1-5	nc
18	BB-13/CN1-17	nc	LL-9/CN2-12
19	BB-11/CN1-19	nc	LL-8/CN2-11
20	BB-9/CN1-18	nc	KK-3/RESET
21	BB-3/CN1-20	QQ-15/BD3-2	nc
22	nc	GRD	VCC
A	GRD	QQ-1/BD1-X	GRD
B	nc	QQ-1/BD1-W	nc
C	II-14/CN3-6	SS-1/BD1-V	nc
D	nc	UU-1/BD1-U	nc
E	7-2/BD3-13	nc	nc
F	C-5/CN2-9	nc	nc
H	C-6/CN2-8	nc	nc
J	B-3/CN2-7	nc	nc
K	B-1/CN2-6	nc	nc
L	A-3/CN2-5	nc	nc
M	A-1/CN2-4	nc	nc
N	nc	nc	nc
P	DD-1/BD3-14	nc	nc
R	nc	nc	nc
S	nc	nc	nc
T	CC-5/CN1-14	nc	nc
U	DD-5/BD2-D	nc	nc
V	DD-4/BD2-C	nc	nc
W	DD-3/BD2-B	nc	nc
X	DD-2/BD2-A	nc	nc
Y	E-15/BD3-6	nc	nc
Z	VCC	nc	nc

Cabinet Connectors

pin	CN1	CN2	CN3
1	GRD	GRD	BD3-3 "CCK"
2	BD1-1 "PIO 0"	BD3-4 "CC - "	BD3-8 "DATA K"
3	BD1-2 "PIO 1"	BD3-5 "CC + "	BD3-11 "KAC"
4	BD1-3 "PIO 2"	BD1-M "MC - "	BD3-12 "KAF"
5	BD1-4 "PIO 3"	BD1-L "MC + "	BD3-15 "TRK"
6	BD1-5 "PIO 4"	BD1-K "DO - "	BD1-3 "PLP"
7	BD1-6 "PIO 5"	BD1-J "DO + "	nc
8	BD1-7 "PIO 6"	BD1-H "TR - "	nc
9	BD1-8 "PIO 7"	BD1-F "TR + "	nc
10	BD1-9 "PIO 8"	BD3-7 "DI - "	nc
11	BD1-10 "PIO 9"	BD3-10 "DI + "	nc
12	BD1-11 "PTO 10"	BD3-9 "AD - "	nc
13	BD1-12 "PTO 11"	BD3-12 "AD + "	nc
14	BD1-T "IOD"	nc	GRD
15	nc	nc	nc
16	BD1-17 "XAR 4"	nc	nc
17	BD1-18 "XAR 5"	nc	nc
18	BD1-20 "XAR 6"	nc	nc
19	BD1-19 "XAR 8"	nc	nc
20	BD1-21 "XAR 13"	nc	nc
21	nc	nc	nc
22	BD1-16 "PTO-15"	nc	nc
23	BD1-15 "PTO-14"	nc	nc
24	BD1-14 "PTO-13"	nc	nc
25	BD1-13 "PTO-12"	nc	nc

E. Discrete Components

Capacitors

.01 uF	HH-1/HH-14
.2 uF	HH-2/HH-13
.20 uF	HH-3/HH-12
.01 uF	HH-4/HH-11
.01 uF	HH-5/HH-10
.47 uF	HH-7/HH-8

Resistors

	Trimmer 1	2	3
A	Y-1	Y-13	Z-7
B	VCC	VCC	VCC
C	VCC	VCC	VCC

APPENDIX B
ATAC OPERATING INSTRUCTIONS

Power Up
    Turn on front panel power then turn on power supplies.

Power Down
    'Halt'
    'Master Clear'
    Power off to supplies, power off to control
    panel.

Run Program
    'Master Clear'
    Dial 'IMR'
    'AUX REG'
    'ENTER' (associated with AUX REG)
    'MEMORY'
    Set start address +1 in keyboard (Hexadecimal)
    'PCP'
    'ENTER' (associated with PCP)
    'RUN'

Stop a Program
    'HALT'

Read Memory (from front panel)
    'HALT'
    Set desired address in key board
    Select 'MAR'
    'ENTER' (associated with MAR)
    'INC' (increment)
    'DEC' (decrement)
    Address is displayed above MAR key, data is displayed in
        red LEDs above MEMORY key.
    Use INC or DEC as necessary to arrive at memory location
        desired.

Write into Memory (from front panel)
    'HALT'
    Set address desired as described in Read Memory.
    Set desired data into keyboard
    'ENTER' (associated with MEMORY)
    Value in keyboard will be entered into either Memory
        (MEMORY) or A computer Register (FILE).

```
Bootstrap Load (paper tape)
     'HALT'
     'MASTER CLEAR'
     'AUX REG'
     Dial 'IMR'
     'ENTER' (associated with AUX REG)
     'MEMORY'
     Set 0001 in keyboard
          (0001 = Load, 0002 = verify only)
     'RUN'
     At  end  of  tape  check program status lights (red LEDs
         below PCR and AAR pushbuttons)


                              0000 = Load good
                              FFFE = Parity error
                              FFFD = Verify error
```

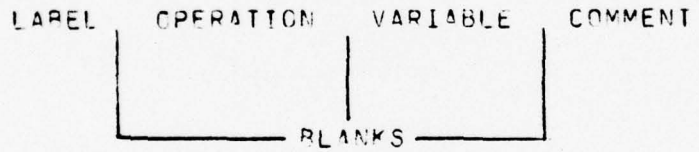
APPENDIX C

ATAC PROGRAM ASSEMBLY

Assembly of a program is divided into five parts; writing, producing absolute deck on IBM 360, conversion of absolute deck into ATAC format, punching paper tape, and loading ATAC.

A. Writing the program.

Programs for the ATAC must be written in the assembly language described in ATAC manuals Volumes One, and Eight. The finished program must be placed on cards for the IBM 360 in the following format:



B. Producing an absolute deck

The first step is to load the assembler on to the IBM 360 from magnetic tape. This is done by executing program A in Appendix E. This transfers the program from tape to disk and saves it for one year. Once the assembler is stored the

following cards placed in the front of a program written following the instructions in I above will produce an absolute deck and a print-out of the program.

```
//ATACASSM JOB (0729,0194,0052),'CCH ATAC ASSEM,',TIME=1
//ASSEM    EXEC PGM=APSS,REGION=220K
//STEPLIB DD  DSN=S0729.ATAC.ONE,UNIT=3330,
//              VOL=SER=DISK02,DISP=SHR
//FT06F001 DD   SYSOUT=A
//FT07F001 DD   SYSOUT=B
//FT05F001 DD   DDNAME=SYSIN
//FT08F001 DD   UNIT=SYSDA,SPACE=(CYL,1)
//FT09F001 DD   UNIT=SYSDA,SPACE=(CYL,(7,2)),
//              DCB=(RECFM=VBS,BLKSIZE=7180,LRECL=92)
//FT10F001 DD   UNIT=SYSDA,SPACE=(CYL,(7,2)),
//              DCB=(RECFM=VBS,BLKSIZE=4204,LRECL=42)
//FT20F001 DD   UNIT=SYSDA,SPACE=(CYL,(7,2)),
//              DCB=(RECFM=VBS,BLKSIZE=2004,LRECL=500)
//SYSPRINT DD   SYSOUT=A
//SYSIN    DD   *
$JOB
$ASSEM
         IDT   ATAC

(place written program here.)

         END
$BASE
$LOAD    P
$END
```

The absolute deck is in the form:

```
0500169c0009adbc3109bc9c3109c8bc7109c09c7109d8b60309bbd932/
                                                  /e10100009c015a
0510160f49c0109f6ed0008aee1010a02ed000230e10109f7ed0007ae/
                                                  /c1070509201258
```

which must be translated for the ATAC. The memory location of the first word is located in the first four columns.

Columns five and six contain the number of word fields on the card. The assembled program is located in columns 7 - 70. The remaining two columns are parity.

C. Conversion

The absolute deck received from the IBM 360 is loaded into the PDP-11. After the data from the cards is checked, the conversion program (convert 'filename' 'filename') can be executed. (Program C in Appendix F)

D. Punching Paper Tape

This code must then be transferred to the PDP-11 (A) where a paper tape can be punched. Here, the command to punch a tape is:

cat 'filename' >/dev/ptp

E. Loading the ATAC

In order to load a tape the RS232 connector must be connected to the Paper Tape reader and the reader set to 1200 baud. The tape is loaded by following the instructions in Appendix B.

APPENDIX D

SAMPLE ATAC OUTPUT

Operator inputs are underlined.

```
Operator Display                        *Comments

EXEC                                    *Executive echos
+JDKDKJFJjjnmun                         *entries other than
JDKDKJFJJJNMJH                          *commands

EXEC
+CO                                     *Entry into CORE

CORE
+CH 0F00 0900                           *Location 0F00
0F00  0900                              *changed to 0900

CORE
+DI 0F00
0F00  0900

CORE
+CS 0F00                                *Locations  0F00 to 0F03
+0256                                   *changed

+0123

+4567

+DO                                     *completion of change
0F00  0256
0F01  0123
0F02  4567

CORE
+DO                                     *Exit from CORE

+NJ                                     *Entry into Receiver
0=SET-UP                                *Control
1=DISPLAY TENTATIVE
2=DISPLAY CONTROL
3=DISPLAY RECEIVED
4=ENTER TENTATIVE
5=SCAN
```

```
6=RECEIVE CONTROL
7=DONE
8=REINITIALIZE

RECEIVER CONTROL
+0

FREQ(HZ)

+1240000
DETECT MODE
0=AM
1=FM
2=BFO FIXED
3=BFO VARIABLE
4=ISB
5=USB
6=LSB
7=AM-NL

+0
GAIN MODE
0=HOLD AGC
2=NORMAL AGC
3=MANUAL AGC

+0
IF BANDWIDTH
1=500 HZ
2=2 KHZ
3=4 KHZ
4=8 KHZ

+4
RF GAIN
(PERCENTAGE)

+88

RECEIVER CONTROL
+1
FREQ = 1240000 HZ
GAIN MODE = HOLD AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQ = 455000 HZ
RF GAIN = 88%

RECEIVER CONTROL
+2
```

```
FREQ = 550000 HZ
GAIN MODE = NORMAL AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQUENCY = 455000 HZ
RF GAIN = 85%

RECEIVER CONTROL
+3
FREQ = 550000 HZ
GAN MODE = NORMAL AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQUENCY = 455000 HZ
RF GAIN = 85%
SIGNAL STRENGTH = 66%

RECEIVER CONTROL
+4

RECEIVER CONTROL
+5
SCAN
START FREQ IN HZ

+1000000
END FREQ IN HZ

+1008000
FREQ INCREMENT IN HZ

+1000
SIGNAL STRENGTH %

+67
FREQ = 1001000
GAIN MODE = HOLD AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQUENCY = 455000 HZ
RF GAIN = 88%
SIGNAL STRENGTH = 72%

RECEIVER CONTROL
+7                                  *Exit from
EXEC                                *Receiver Control
+
```

APPENDIX E
CONVERSION PROGRAMS FOR THE ASSEMBLER

A. This program is run on the IBM-360 to transfer the ATAC assembler from tape ATT-006 to Disk and stores it there for one year.

```
// [GREEN JOB CARD]
//SYSPRINT DD   SYSOUT=A
//SYSUT1   DD   UNIT=SYSDA,SPACE=(TRK,(40),,CONTIG)
//DA1      DD   UNIT=2314,DSN=S0729.ATAC.ONE,
//              SPACE=(TRK,(50,10,10),,CONTIG),
//              DISP=(NEW,KEEP),VOL=SER=SPOOL3
//T1TAPE DD UNIT=(2400,,DEFER),DISP=(NEW,PASS),
//               LABEL=(3,SL,,IN),
//              DCB=(DEN=2,BLKSIZE=800,LRECL=80,RECFM=FB),
//              VOL=SER=ATI006
//SYSIN    DD   *
         COPY   PDS=ATI.APSS.LOADLIB,TO=2314=SPOOL3,
                FROMDD=T1TAPE,FROM=2400=(ATI006,3),
                RENAME=S0729.ATAC.ONE
/*
//BUILD    EXEC PGM=IEWL,REGION=150K,
//           PARM='OVLY,XREF,LET,LIST,SIZE=(256K,20480)'
//SYSPRINT DD   SYSOUT=A
//LIBRARY DD DSN=S0729.ATAC.ONE,UNIT=2314,VOL=SER=SPOOL3,
//              DISP=SHR
//SYSLIB DD DSNAME=SYS1.FORTLIB,DISP=SHR
//SYSLMOD DD DSNAME=S0729.ATAC.ONE,
//               UNIT=3330,VOL=SER=DISK02,
//              DISP=(NEW,KEEP),LABEL=RETPD=360,
//              SPACE=(CYL,(5,1,2),RLSE)
//SYSUT1 DD UNIT=SYSDA,SPACE=(TRK,(19,19),,CONTIG),
//              SEP=SYSLMOD
//SYSLIN   DD   *
 INCLUDE LIBRARY(PMODL)
 CHANGE MSIM(IHESAPD)
 INCLUDE LIBRARY(APSSMON)
 INCLUDE LIBRARY(MSIMM,ASEM5,SIM16A,SIMTR1,SIMIO1,GUL)
 INCLUDE LIBRARY(XPLMON)
 OVERLAY A1
 INSERT MSIMUL,*MSIMULA,IHENTRY,IHESAP
 INSERT MINT,IN,OUT
 INSERT IHEDBN,IHEXTD
```

```
 INSERT IHERSM,IHECSM
 INSERT IHERSK,IHEIOX,IHEIOP,IHEDID,IHEDOB
 INSERT IHEDIB,IHEDCA,IHETOB
 INSERT IHEIOA,IHEOCL
 INSERT IHERSD,IHEBSF
 INSERT IHEJXS
 INSERT IHEOSD,IHEOST,IHERST
 INSERT IHEVPF,IHEDMA,IHEVFB
 INSERT IHEDNC,IHEVFD,IHEVFA,IHEVPD,IHEVPB,IHEVSC
 INSERT IHEVSD,IHEVFE,IHEDCN,IHEUPB
 INSERT IHEVFC,IHEVPE,IHEVPG,IHEVQB,IHEVGC
 INSERT IHEABN,IHEIOD,IHETOF,IHEPRT,IHEVQA,IHESPRT
 INSERT IHEREG,IHEERR,IHESIZ
 INSERT MTSET
 OVERLAY A1
 INSERT ASSFN,REWIND,REW72,DSKOUT,CARDIN,DISKIN,ERPRT,PRIADD
 INSERT WRDATA,PRTCOM,PRINOR,WRTTEX,REFTIT,PREF,ERTTT
 OVERLAY A1
 INSERT PARMRD,PRESTM
 OVERLAY A1
 INSERT SMLTR,DRMTRM,STRTSM,TRACE
 INSERT RDCRD,ABNPMT,ARTHEP,TRACE,HGRAM,HGRAMI,HGRAMS
 INSERT IOINIT,ACTIVE,STMTIM
 INSERT DEVDTA,ACT,TIME,INT,RAND,DEADT,DEBUG
 OVERLAY A2
 INSERT LEVEL,DMATOI,DMAIOA,DMAIOD,RIOIO
 INSERT REMACT,DMA,DMAIM,RIO,RIOTM,RIOINT,INTOLY,DMAINT
 INSERT DTRAN,PUTACT,RANDOM
 OVERLAY A1
 INSERT HGPRNT
 OVERLAY A1
 INSERT LOADER
 OVERLAY A1
 INSERT LINK,ENTEXT,SLEW
 OVERLAY A1
 INSERT PLATAC,IOPACK
 OVERLAY $OBJECT(REGION)
 INSERT OBJECT,INIT,LIB,RCALPH,RCHEX,RCINT
 INSERT MDATE
 OVERLAY $DUMP(REGION)
 INSERT SMDUMP,PAGE
 ENTRY MAIN
 NAME APSS
/*
//          EXEC PGM=IEBCOPY
//SYSPRINT DD   SYSOUT=A
//SYSUT1   DD   DISP=SHR,UNIT=2314,VOL=SER=SPOOL3,
//              DSN=S0729.ATAC.ONE
//SYSUT2 DD DISP=(NEW,PASS),UNIT=3330,VOL=SER=DISK02,
//          DSN=S0729.ATAC.TWO,
```

```
//            SPACE=(13030,(61,0,14),RLSE),
//               DCB=(RECFM=U,BLKSIZE=13030),
//               ,LABEL=RETPD=360
//SYSUT3    DD   UNIT=SYSDA,SPACE=(TRK,(20,5))
//SYSUT4    DD   UNIT=SYSDA,SPACE=(TRK,(20,5))
//SYSIN     DD   *
          COPY OUTDD=SYSUT2,INDD=SYSUT1
```

8. This program converts the IBM-360 absolute deck into correct format for the ATAC.

```
main (argc, *argv)
   int argc;
   char *argv [];
   {register crctr, index, jndex;
    int stchr;
    int tmpry [75];
    struct buffr
       {int fldes;
        int nleft;
        char *nextp;
        char *buffs [512];
       } bufin, bufot, *pntr1, *pntr2;
    stchr = 020;
    if (argc != 3)
       {printf ("Calling arguments are incorrect#");
        exit (0);
       }
    bufin.fldes = open (argv [1], 0);
    if (bufin.fldes < 0)
       {printf ("Cannot open %s#", argv [1]);
        exit (0);
       }
    pntr1 = &bufin.fldes;
    bufot.fldes = creat (argv [2], 0777);
    if (bufot.fldes < 0)
       {printf ("Cannot open %s#", argv [2]);
        exit (0);
       }
    pntr2 = &bufot.fldes;
    putc (stchr, pntr2);
    while (crctr >= 0 && index <= 72)
        tmpry [index++] = (crctr = getc (pntr1));
    index -= 3;
    jndex = 0;
    while (jndex < 4 && jndex < index)
```

```
        putc (tmpry [jndex++], pntr2);
    jndex = jndex + 2;
    while (crctr >= 0)
       {while (jndex < index)
           {if (tmpry [jndex] == '#')
                jndex++;
              else
                putc (tmpry [jndex++], pntr2);
           }
        index = 0;
        while (crctr >= 0 && index <= 72)
            tmpry [index++] = (crctr = getc (pntr1));
        index -= 3;
        jndex = 0;
       }
    putc (stchr, pntr2);
    fflush (pntr2);
    close (bufin.fdes);
    close (bufot.fdes);
}
```

C. The following program executes the program above and converts the output into the correct code.

```
atac $1 $2 -
if ! -r $2 exit
mv $2 temp2
tr "[0*]" "[040*]" <temp2 >temp1
tr "[1*]" "[001*]" <temp1 >temp2
tr "[2*]" "[002*]" <temp2 >temp1
tr "[3*]" "[043*]" <temp1 >temp2
tr "[4*]" "[004*]" <temp2 >temp1
tr "[5*]" "[045*]" <temp1 >temp2
tr "[6*]" "[046*]" <temp2 >temp1
tr "[7*]" "[007*]" <temp1 >temp2
tr "[8*]" "[010*]" <temp2 >temp1
tr "[9*]" "[051*]" <temp1 >temp2
tr "[a*]" "[052*]" <temp2 >temp1
tr "[b*]" "[013*]" <temp1 >temp2
tr "[c*]" "[054*]" <temp2 >temp1
tr "[d*]" "[015*]" <temp1 >temp2
tr "[e*]" "[016*]" <temp2 >temp1
tr "[f*]" "[057*]" <temp1 >$2
rm temp1 temp2
```

APPENDIX F

ATAC PROGRAM

The following programs are listings of the Main System and Receiver Control programs for the ATAC. The assembly language is to the right of the absolute listing of the first three columns.

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
                            IDT   ATAC                                                    1
0000                        DS    0100                                                  2
                            ENTRY EXEC                                                  3
                      WJ    EQU   0500                                                  4
                      .                                                                 5
                      .                                                                 6
                      .                                                                 7
                      .                                                                 8
                      .*****************************************************************9
                      . EXEC                                                           *10
                      .                                                                *11
                      . EXECUTIVE PROGRAM FOR SYSTEM.  HANDLES REQUESTS SUBMITTED      *12
                      . THROUGH KEYMR                                                  *13
                      .*****************************************************************14
                      .                                                                 15
                      . ******************                                            16
                      . ESTABLISH EQUATES                                               17
                      . ******************                                            18
                      .                                                                 19
                      EADD  EQU   1                 ADDRESS OF INPUT BUFFER           20
                      EZ    EQU   2                 CONSTANT ZERO                     21
                      EONE  EQU   3                 CONSTANT ONE                      22
                      EL    EQU   4                 LOWER BYTE OF REQUEST             23
                      EXCAD EQU   5                 ADDRESS OF REQUESTED ROUTINE      24
                      EU    EQU   6                 UPPER BYTE OF REQUEST             25
                      EC    EQU   7                 COUNT OF WORDS IN BUFFER          26
                      .                                                                 27
                      .                                                                 28
                      .                                                                 29
                      . *********                                                       30
                      . EXECUTIVE                                                       31
                      . *********                                                       32
                      .                                                                 33
                      .                                                                 34
0100  E201 014D       EXEC  LDR   D,EADD,ETITLE     GET TITLE ADDRESS                 35
0102  ED00 0230             BAL   I,0,OUTPUT        OUTPUT TITLE                      36
0104  ED00 0151             BAL   I,RET,KEYMR       GET PROGRAM REQUEST               37
0106  9CF0 0136             STRM  D,0,EXECS,16      SAVE ALL REGISTERS                38
                      .                                                                 39
                      . GET FIRST TWO LETTERS OF REQUEST                                40
                      .                                                                 41
0108  4013                   LDR   IS,EONE,1        SET UP CONSTANT                   42
0109  4002                   LDR   IS,EZ,0          SET UP CONSTANT                   43
010A  5217                   LDR   RX,EC,EADD,EZ    GET COUNT OF WORDS IN BUFFER      44
010B  6011             EX1   ADD   IS,EADD,1        INCREMENT BUFFER POINTER          45
010C  5216                   LDR   RX,EU,EADD,EZ    GET WORD FROM BUFFER              46
010D  6FF7                   ADD   IS,EC,-1         DECREMENT WORD COUNT              47
010E  C106 0100              BRCL  NP,EXEC          GET OUT IF NOT THERE              48
0110  2206                   CMP   IS,EU,020        COMPARE WITH SPACE                49
0111  C102 010B              BRCL  EQ,EX1           IF SPACE, KEEP LOOKING            50
0113  AE76                   SHS   LL,EU,8          POSITION UPPER BYTE               51
0114  5314                   LDR   RX,EL,EADD,EONE  GET NEXT WORD IN BUFFER           52
0115  AE74                   SHS   LL,EL,8          CLEAR UPPER BYTE                  53
0116  AD74                   SHS   RL,EL,8          POSITION LOWER BYTE               54
```

```
LOC   OBJECT CODE      CARD IMAGE                                                                    CARDNUM
0117  A446                      IOR   R,EU,EL             COMBINE FIRST TWO BYTES OF COMMAND
                       .
0118  B106 776A                 CMP   I,EU,0776A          SEE IF REQUEST FOR WJ
011A  C102 012A                 BRCL  EQ,EX2              GO CALL WJ
                       .
011C  0000                      NOP                       PATCH AREA FOR ANOTHER REQUEST
011D  0000                      NOP
011E  0000                      NOP
011F  0000                      NOP
                       .
                       . ECHO EXIT - INVALID REQUEST
                       .
0120  BCF0 0136                 LDRM  D,0,EXECS,16        RESTORE REGISTERS
0122  ED00 0230                 BAL   I,0,OUTPUT          ECHO INPUT BUFFER
0124  E101 014A                 LDR   I,1,EXCRLF          GET ADDRESS OF CR/LF BUFFER
0126  ED00 0230                 BAL   I,0,OUTPUT          OUTPUT CR/LF
0128  C107 0100                 BRC   I,7,EXEC            GO TRY AGAIN
                       .
                       . CALL RECEIVER CONTROL PROGRAM
                       .
012A  ED00 0500        EX2      BAL   I,RET,WJ            GO TO WJ
012C  C107 0100                 BRCL  U,EXEC
                       .
                       . PATCH AREA FOR ANOTHER REQUEST
                       .
012E  0000                      NOP
012F  0000                      NOP
0130  0000                      NOP
0131  0000                      NOP
0132  0000                      NOP
0133  0000                      NOP
0134  C107 0100                 BRCL  U,EXEC
                       .
                       .
                       .
                       .
                       . ****
                       . DATA
                       . ****
                       .
0136                   EXECS    DS    20                  SAVE AREA FOR REGISTERS
                       .
014A  0001             EXCRLF   DC    1
014B  0D0A                      DC    00D0A               CR/LF
014C  0000                      DC    0
014D  0003             ETITLE   DC    3                   COUNT
014E  4558                      DC    04558               EX
014F  4543                      DC    04543               EC
0150  0000                      DC    0                   NULL
                       .
                       .
                       .
                       .
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                    CARDNUM
                      *************************************************************
                      . SYSTEM EQUATES                                              *
                      .                                                             *
                      . THESE ARE EQUATES THAT ARE USED FOR LINKAGE BETWEEN         *
                      . PROGRAMS OR THAT ARE USED BY AT LEAST TWO PROGRAMS IN       *
                      . THE SYSTEM                                                  *
                      *************************************************************
                      .
                      RET      EQU   0                     RETURN REGISTER
                      .
                      .
                      *************************************************************
                      . KEYMR                                                       *
                      .                                                             *
                      . ROUTINE TO READ DATA FROM THE KEYBOARD                      *
                      .                                                             *
                      . CALLING PROCEDURE:                                          *
                      .        BAL    I,0,KEYMR                                     *
                      .                                                             *
                      . INPUTS:                                                     *
                      .       NONE                                                  *
                      .                                                             *
                      . OUTPUTS:                                                    *
                      .     REG 1       ADDRESS OF BUFFER CONTAINING THE KEYBOARD   *
                      .                 ENTRY (ONE CHARACTER PER WORD, RIGHT        *
                      .                 JUSTIFIED, ASCII)                           *
                      .                 THE FIRST WORD OF THE BUFFER CONTAINS THE   *
                      .                 NUMBER OF CHARACTERS IN THE KEYBOARD        *
                      .                 ENTRY BUFFER                                *
                      .                                                             *
                      . ROUTINES CALLED:                                            *
                      .     OUTPUT                                                  *
                      .                                                             *
                      . THIS ROUTINE PRESERVES NO REGISTERS                         *
                      *************************************************************
                      .
                      .
                      *****************
                      . ESTABLISH EQUATES
                      *****************
                      .
                      KRET     EQU   0                     RETURN REGISTER
                      KBUF     EQU   1                     ADDRESS OF BUFFER HOLDING KEYBOARD
                      .                                    ENTRY
                      KPC      EQU   5                     POSITION COUNTER FOR NEXT INPUT
                      .                                    INPUT FROM KEYBOARD (CURSOR)
                      KPM      EQU   6                     MAX POSITION USED IN KEYBOARD ENTRY
                      .                                    (NUMBER OF CHARACTERS ENTERED)
                      KOR      EQU   7                     OUTPUT REGISTER
                      KIR      EQU   8                     INPUT REGISTER
                      KOUT     EQU   9                     OUTPUT DEVICE ADDRESS
                      KIN      EQU   10                    INPUT DEVICE ADDRESS
                      KV1      EQU   11                    VARIABLE 1
```

```
LOC   OBJECT CODE    CARD IMAGE
                     KV2      EQU   12                         VARIABLE 2
                     KV3      EQU   13                         VARIABLE 3
                     KDATA    EQU   14                         INPUT DATA FROM KEYBOARD
                     .
                     .
                     .
                     .
                     . *********************
                     . INITIALIZE AND SET UP
                     . *********************
                     .
0151  9C00 01D6      KEYMR    STR   D,KRET,RETURN              SAVE RETURN ADDRESS
0153  E101 0228      KMR1     LDR   I,KBUF,KBSTRT              GET ADDRESS OF BUFFER TO OUTPUT
0155  ED00 0230               BAL   I,KRET,OUTPUT              OUTPUT INITIAL BUFFER
0157  E10A FFBF               LDR   I,KIN,0FFBF                DEVICE ADDRESS FOR INPUT
0159  E109 BFFF               LDR   I,KOUT,0BFFF               DEVICE ADDRESS FOR OUTPUT
015B  4015                    LDR   IS,KPC,1                   POSITION COUNTER = 1
015C  4016                    LDR   IS,KPM,1                   MAX POSITION USED = 1
015D  E101 01D7               LDR   I,KBUF,KBUFFER             ADDRESS OF BUFFER TO REGISTER
015F  E107 8000               LDR   I,KOR,08000                RESET CODE
0161  D997                    ROUT  KOR,KOUT                   RESET KEYBOARD
                     .
                     . ***************************************
                     . SET KEYBOARD ENTRY BUFFER TO ALL SPACES
                     . ***************************************
                     .
0162  450B                    LDR   IS,KV1,80                  SET COUNTER TO BUFFER LENGTH
0163  E01C                    LDR   R,KV2,KBUF                 GET BUFFER ADDRESS
0164  420D                    LDR   IS,KV3,020                 CODE FOR SPACE
0165  1BCD           KMR2     STR   RX,KV3,KV2,KV1             STORE BLANK CODE
0166  6FFB                    ADD   IS,KV1,-1                  DECREMENT COUNTER
0167  C101 0165               BRCL  GT,KMR2                    DO AGAIN IF COUNTER GT 0
                     .
                     . *********************
                     . GET DATA FROM KEYBOARD
                     . *********************
                     .
0169  E107 8000      KMR3     LDR   I,KOR,08000                RESET CODE
016B  D997                    ROUT  KOR,KOUT                   RESET KEYBOARD

016C  8CAE           KMR4     RIN   KDATA,KIN                  GET DATA
016D  9E0E 4000               CMPL  I,KDATA,04000              DATA PRESENT ?
016F  C105 016C               BRCL  NE,KMR4                    NO DATA, WAIT

0171  E107 8000      KMR5     LDR   I,KOR,08000                RESET CODE
0173  D997                    ROUT  KOR,KOUT                   RESET KEYBOARD
0174  8CA8                    RIN   KIR,KIN                    GET STATUS
0175  9E08 2000               CMPL  I,KIR,02000                DATA STILL PRESENT ?
0177  C102 0171               BRCL  EQ,KMR5                    KEEP TRYING TO CLEAR
                     .
                     . *************
                     . DATA OBTAINED
                     . *************
```

```
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LOC    OBJECT CODE       CARD IMAGE                                                                 CARDNUM

                    .
0179   A10E 007F              AND   I,KDATA,0007F          SAVE DATA ONLY
                    .
017B   208E                   CMP   IS,KDATA,008           COMPARE WITH BACKSPACE
017C   C105 0184              BRCL  NE,KMR6                NOT BACKSPACE
017E   6FF5                   ADD   IS,KPC,-1              DECREMENT POINTER
017F   C105 0169              BRCL  NZ,KMR3                LOOK FOR DATA IF PC NOT ZERO
0181   4015                   LDR   IS,KPC,1                SET PC = 1
0182   C107 0169              BRCL  U,KMR3                 GET MORE DATA
                    .
0184   21CE         KMR6      CMP   IS,KDATA,01C           COMPARE WITH FORWARD SPACE
0185   C105 0190              BRCL  NE,KMR8                NOT FORWARD SPACE
0187   6015         KMR7      ADD   IS,KPC,1               INCREMENT POSITION COUNTER
0188   B105 0050              CMP   I,KPC,80               COMPARE WITH MAX VALUE
018A   C106 0169              BRCL  LE,KMR3                LESS OR EQUAL MAX, GET MORE DATA
018C   E105 0050              LDR   I,KPC,80               SET POSITION COUNTER TO 80
018E   C107 01B9              BRCL  U,KMR11                GET OUT OF ROUTINE
                    .
0190   20DE         KMR8      CMP   IS,KDATA,00D           COMPARE WITH CARRIAGE RETURN
0191   C102 01B9              BRCL  EQ,KMR11               CR, GET OUT
                    .
0193   22EE                   CMP   IS,KDATA,02E           COMPARE WITH DECIMAL POINT
0194   C102 01B1              BRCL  EQ,KMR10               DECIMAL POINT, PUT IN BUFFER
                    .
0196   220E                   CMP   IS,KDATA,020           COMPARE WITH SPACE
0197   C102 01B1              BRCL  EQ,KMR10               SPACE, PUT IN BUFFER
                    .
0199   230E                   CMP   IS,KDATA,030           COMPARE WITH 0
019A   C104 01AB              BRCL  LT,KMR9                ILLEGAL CHARACTER
                    .
019C   239E                   CMP   IS,KDATA,039           COMPARE WITH 9
019D   C106 01B1              BRCL  LE,KMR10               NUMERIC, PUT IN BUFFER
                    .
019F   241E                   CMP   IS,KDATA,041           COMPARE WITH UPPER CASE A
01A0   C104 01AB              BRCL  LT,KMR9                ILLEGAL CHARACTER
                    .
01A2   25AE                   CMP   IS,KDATA,05A           COMPARE WITH UPPER CASE Z
01A3   C106 01B1              BRCL  LE,KMR10               UPPER CASE ALPHA, PUT IN BUFFER
                    .
01A5   261E                   CMP   IS,KDATA,061           COMPARE WITH LOWER CASE A
01A6   C104 01AB              BRCL  LT,KMR9                ILLEGAL CHARACTER
                    .
01A8   27AE                   CMP   IS,KDATA,07A           COMPARE WITH LOWER CASE Z
01A9   C106 01B1              BRCL  LE,KMR10               LOWER CASE ALPHA, PUT IN BUFFER
                    .
                    .  *************
                    .  ILLEGAL ENTRY
                    .  *************
                    .
01AB   E101 022C    KMR9      LDR   I,KBUF,KBILL           GET ADDRESS OF ILLEGAL BUFFER
01AD   ED00 0230              BAL   I,KRET,OUTPUT          OUTPUT BUFFER
01AF   C107 0153              BRCL  U,KMR1                 START OVER
                    .
```

```
LOC   OBJECT CODE      CARD IMAGE                                                                    CARDNUM
                       . ****************************                                                  267
                       . VALID ENTRY - PUT IN BUFFER                                                   268
                       . ****************************                                                  269
                       .                                                                               270
01B1  9B5E 01D7        KMR10    STR   DX,KDATA,KBUFFER,KPC  PUT DATA IN BUFFER                         271
01B3  B056                      CMP   R,KPM,KPC             COMPARE MAX USED WITH LAST POSITIO         272
01B4  C103 0187                 BRCL  GE,KMR7               GO INCREMENT POSITION COUNTER              273
01B6  E056                      LDR   R,KPM,KPC             PM = PC                                    274
01B7  C107 0187                 BRCL  U,KMR7                KEEP GETTING DATA                          275
                       .                                                                               276
                       . ****                                                                          277
                       . EXIT                                                                          278
                       . ****                                                                          279
                       .                                                                               280
01B9  9C06 01D7        KMR11    STR   D,KPM,KBUFFER         PUT COUNT IN BUFFER                        281
                       .-----------------------------------------------------------------------        282
                       . THIS IS THE SEQUENCE FOR CALLING 'CORE' (UTILITY TO DISPLAY AND               283
                       . CHANGE CORE INTERACTIVELY). ALL CODE BETWEEN DOTTED LINES MAY BE              284
                       . REMOVED WHEN A CALL TO THAT PROGRAM IS NO LONGER DESIRED.                     285
01EB  E01B                      LDR   R,KV1,KBUF                                                       286
01BC  4005                      LDR   IS,KPC,0                                                         287
01BD  601B             KMR30    ADD   IS,KV1,1                                                         288
01BE  55BC                      LDR   RX,KV2,KV1,KPC                                                   289
01BF  6FF6                      ADD   IS,KPM,-1                                                        290
01C0  C106 01D3                 BRCL  NP,KMR12                                                         291
01C2  220C                      CMP   IS,KV2,020                                                       292
01C3  C102 01BD                 BRCL  EQ,KMR30                                                         293
01C5  601B                      ADD   IS,KV1,1                                                         294
01C6  AE7C                      SHS   LL,KV2,8                                                         295
01C7  55BD                      LDR   RX,KV3,KV1,KPC                                                   296
01C8  AE7D                      SHS   LL,KV3,8                                                         297
01C9  AD7D                      SHS   RL,KV3,8                                                         298
01CA  80DC                      ADD   R,KV2,KV3                                                        299
01CB  B10C 636F                 CMP   I,KV2,0636F                                                      300
01CD  C105 01D3                 BRCL  NE,KMR12                                                         301
01CF  E202 01D6                 LDR   D,2,RETURN            GET ADDRESS OF CALLING ROUTINE             302
01D1  C107 02F8                 BRC   I,7,CORE              GO PROCESS CORE REQUEST                    303
                       ------------------------------------------------------------------------        304
01D3  E200 01D6        KMR12    LDR   D,KRET,RETURN         RESTORE RETURN ADDRESS                     305
01D5  BF07                      BRC   R,7,KRET              RETURN                                     306
                       .                                                                               307
                       .                                                                               308
                       .                                                                               309
                       .                                                                               310
                       .                                                                               311
                       . ****                                                                          312
                       . DATA                                                                          313
                       . ****                                                                          314
                       .                                                                               315
                       .                                                                               316
01D6                   RETURN   DS    1                     RETURN ADDRESS STORAGE                     317
                       .                                                                               318
                       . *********************                                                         319
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
                    . KEYBOARD ENTRY BUFFER                                          320
                    . ************************                                       321
                    .                                                                322
01D7  0050          KBUFFER  DC    80                 COUNT                        323
01D8                         DS    80                 RESERVE                      324
                    .                                                                325
                    . ********************                                         326
                    . START SYMBOL BUFFER                                          327
                    . ********************                                         328
                    .                                                                329
0228  0003          KBSTRT   DC    3                  COUNT                        330
0229  0D0A                   DC    00D0A              CR/LF                        331
022A  002B                   DC    002B               +                            332
022B  0000                   DC    00000              NULL                         333
                    .                                                                334
                    . *************************                                    335
                    . ILLEGAL CHARACTER BUFFER                                     336
                    . *************************                                    337
                    .                                                                338
022C  0003          KBILL    DC    3                  COUNT                        339
022D  0A07                   DC    00A07              CR,BELL                      340
022E  0707                   DC    00707              BELL,BELL                    341
022F  0000                   DC    00000              NULL                         342
                    .                                                                343
                    .                                                                344
                    .                                                                345
                    .                                                                346
                    . ************************************************************ 347
                    . OUTPUT                                                       * 348
                    .                                                              * 349
                    . ROUTINE TO OUTPUT TO THE TTY/CRT                             * 350
                    .                                                              * 351
                    . CALLING PROCEDURE:                                           * 352
                    .       BAL   I,0,OUTPUT                                       * 353
                    .                                                              * 354
                    . INPUTS:                                                      * 355
                    .    REG 1     ADDRESS OF BUFFER TO BE OUTPUT                  * 356
                    .                                                              * 357
                    . THE BUFFER MUST BE SET UP IN THE FOLLOWING MANNER:           * 358
                    .    WORD 1    N = NUMBER OF WORDS IN BUFFER TO BE OUTPUT      * 359
                    .    WORDS 2-N ASCII DATA TO BE OUTPUT, TWO ASCII             * 360
                    .              CHARACTERS PER WORD                             * 361
                    .                                                              * 362
                    . OUTPUTS:                                                     * 363
                    .    NONE                                                      * 364
                    .                                                              * 365
                    . ROUTINES CALLED:                                             * 366
                    .    NONE                                                      * 367
                    .                                                              * 368
                    . THIS ROUTINE PRESERVES NO REGISTERS                          * 369
                    . ************************************************************ 370
                    .                                                                371
                    .                                                                372
```

```
LOC   OBJECT CODE    CARD IMAGE                                                                  CARDNUM
                    . ****************
                    . ESTABLISH EQUATES
                    . ****************
                    .
                    BUFAD    EQU   1                        ADDRESS OF BUFFER TO OUTPUT
                    BO       EQU   5                        OUTPUT BUFFER ADDRESS
                    VIN      EQU   6                        INPUT DEVICE ADDRESS
                    VOUT     EQU   7                        OUTPUT DEVICE ADDRESS
                    VL       EQU   8                        INPUT BUFFER LOWER BYTE
                    VU       EQU   9                        INPUT BUFFER UPPER BYTE
                    WO       EQU   10                       NUMBER OF WORDS TO OUTPUT
                    WI       EQU   11                       NUMBER OF WORDS TO INPUT
                    VIU      EQU   12                       UPPER BYTE INDEX
                    VIL      EQU   13                       LOWER BYTE INDEX
                    STAT     EQU   14                       STATUS
                    WOUT     EQU   15                       WORD TO OUTPUT TO TTY
                    .
                    .
                    .
                    .
                    . *******************************
                    . INITIALIZE AND SET UP CONSTANTS
                    . *******************************
                    .
0230  400C          OUTPUT   LDR   IS,VIU,0                 INDEX FOR STORING UPPER BYTE
0231  401D                   LDR   IS,VIL,1                 INDEX FOR STORING LOWER BYTE
0232  E106 FFBF              LDR   I,VIN,OFFBF              INPUT DEVICE ADDRESS
0234  E107 BFFF              LDR   I,VOUT,OBFFF             OUTPUT DEVICE ADDRESS
0236  51CB                   LDR   RX,WI,VIU,BUFAD          GET INPUT WORD COUNT
0237  9C0C 026A     OUT5     STR   D,VIU,COUNT              INITIALIZE COUNT
0239  200B                   CMP   IS,WI,0                  COMPARE WORD COUNT WITH ZERO
023A  C106 0269              BRCL  LE,OUT4                  GET OUT IF COUNT LESS THAN ZERO
023C  228B                   CMP   IS,WI,40                 COMPARE WITH MAX VALUE
023D  C106 0242              BRCL  LE,OUT3                  IF IN LIMIT KEEP GOING
023F  9C0B 026A              STR   D,WI,COUNT               SAVE ORIGINAL COUNT
0241  428B                   LDR   IS,WI,40                 ONLY OUTPUT 40 WORDS
0242  E0BA          OUT3     LDR   R,WO,WI                  PUT IN OUTPUT WORD COUNT
0243  AE0A                   SHS   LL,WO,1                  DOUBLE FOR OUTPUT WORD COUNT
0244  E105 026B              LDR   I,BO,BUFOUT              GET OUTPUT BUFFER ADDRESS
                    .
                    . *********************************************
                    . TRANSFER INPUT BYTE BUFFER TO OUTPUT WORD BUFFER
                    . *********************************************
                    .
0246  6011          OUT1     ADD   IS,BUFAD,1               INCREMENT INPUT POINTER TO NEXT ENTR
0247  51C9                   LDR   RX,VU,VIU,BUFAD          GET INPUT WORD IN UPPER BYTE REGISTE
0248  E098                   LDR   R,VL,VU                  PUT IN LOWER BYTE REGISTER ALSO
0249  AE78                   SHS   LL,VL,8                  CLEAR UPPER BYTE
024A  AD78                   SHS   RL,VL,8                  RIGHT JUSTIFY LOWER BYTE
024B  AD79                   SHS   RL,VU,8                  RIGHT JUSTIFY UPPER BYTE
024C  15C9                   STR   RX,VU,VIU,BO             STORE UPPER BYTE AS FULL WORD
                    .                                       IN THE OUTPUT BUFFER
024D  15D8                   STR   RX,VL,VIL,BO             STORE LOWER BYTE AS FULL WORD
```

```
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LOC   OBJECT CODE    CARD IMAGE                                                                   CARDNUM
                     .                              IN THE OUTPUT BUFFER
024E  6025                   ADD    IS,BO,2         INCREMENT OUTPUT BUFFER POINTER
024F  6FFB                   ADD    IS,WI,-1        DECREMENT NUMBER OF WORDS TO INPUT
0250  C101 0246              BRCL   GT,OUT1         DO AGAIN IF NOT FINISHED
                     .
                     . ******************
                     . OUTPUT WORD BUFFER
                     . ******************
                     .
0252  E105 026B              LDR    I,BO,BUFOUT     GET ADDRESS OF OUTPUT BUFFER
0254  8C6E           OUT2    RIN    STAT,VIN        GET STATUS
0255  9E0E 1000              CMPL   I,STAT,01000    COMPARE STATUS
0257  C105 0254              BRCL   NE,OUT2         WAIT IF NOT READY
0259  B75F 0000              LLC    DX,WOUT,0,BO    GET CHARACTER TO OUTPUT
025B  A10F 01FF              AND    I,WOUT,001FF    CLEAR ALL BUT OUTPUT DATA
025D  D97F                   ROUT   WOUT,VOUT       OUTPUT A CHARACTER
025E  6015                   ADD    IS,BO,1         INCREMENT BUFFER POINTER
025F  6FFA                   ADD    IS,WO,-1        DECREMENT WORD COUNTER
0260  C101 0254              BRCL   GT,OUT2         GO OUTPUT ANOTHER CHARACTER
                     .
                     . ****
                     . EXIT
                     . ****
                     .
0262  E20B 026A              LDR    D,WI,COUNT      GET EXCESS COUNT
0264  C102 0269              BRCL   Z,OUT4          GET OUT IF ZERO
0266  6D8B                   ADD    IS,WI,-40       DECREMENT BY 40
0267  C107 0237              BRCL   U,OUT5          DO AGAIN
C269  BF07           OUT4    BRC    R,7,RET
                     .
                     . ****
                     . DATA
                     . ****
                     .
026A                 COUNT   DS     1               SAVE LOCATION FOR EXCESS COUNT
                     .
026B                 BUFOUT  DS     80              OUTPUT BUFFER
                     .
                     .
                     .
                     . ***********************************************************
                     . HEXA                                                      *
                     .                                                           *
                     . ROUTINE TO CONVERT HEX TO ASCII                           *
                     .                                                           *
                     . CALLING PROCEDURE:                                        *
                     .         BAL    I,0,HEXA                                   *
                     .                                                           *
                     . INPUTS:                                                   *
                     .     REG 1      HEX VALUE TO BE CONVERTED (INTEGER)        *
                     .                                                           *
                     . OUTPUTS:                                                  *
```

```
LOC   OBJECT CODE      CARD IMAGE                                                                     CARDNUM
                     .      REG 2      MOST SIGNIFICANT TWO DIGITS IN ASCII             *
                     .      REG 3      LEAST SIGNIFICANT TWO DIGITS IN ASCII            *
                     .      LETTERS ARE OUTPUT IN UPPER CASE                            *
                     .                                                                  *
                     . ROUTINES CALLED:                                                 *
                     .      NONE                                                        *
                     .                                                                  *
                     . THIS ROUTINE DOES NOT DISTURB REGISTERS 5 THROUGH 15             *
                     . *****************************************************************
                     .
                     .
                     . *****************
                     . ESTABLISH EQUATES
                     . *****************
                     .
                     HIN        EQU    1                    HEX VALUE INPUT
                     MSD        EQU    2                    MOST SIGNIFICANT DIGITS TO OUTPUT
                     LSD        EQU    3                    LEAST SIGNIFICANT DIGITS TO OUTPUT
                     V1         EQU    4                    VARIABLE
                     .
                     .
                     .
                     .
                     . ****************
                     . CONVERT TO ASCII
                     . ****************
                     .
02BB  9C00 02E1      HEXA       STR    D,RET,HEXRTN         SAVE RETURN REGISTER
02BD  E014                      LDR    R,V1,HIN             GET HEX INPUT VALUE
02BE  ADB4                      SHS    RL,V1,12             RIGHT JUSTIFY FIRST DIGIT
02BF  ED00 02DB                 BAL    I,RET,HEXA1          CONVERT FIRST DIGIT
02C1  AE74                      SHS    LL,V1,8              POSITION DIGIT
02C2  E042                      LDR    R,MSD,V1             PUT IN OUTPUT REGISTER
02C3  E014                      LDR    R,V1,HIN             GET HEX INPUT VALUE
02C4  AD74                      SHS    RL,V1,8              RIGHT JUSTIFY SECOND DIGIT
02C5  A104 000F                 AND    I,V1,0000F           CLEAR ALL BUT SECOND DIGIT
02C7  ED00 02DB                 BAL    I,RET,HEXA1          CONVERT SECOND DIGIT
02C9  8042                      ADD    R,MSD,V1             PUT IN OUTPUT REGISTER
02CA  E014                      LDR    R,V1,HIN             GET HEX INPUT VALUE
02CB  A104 00F0                 AND    I,V1,000F0           CLEAR ALL BUT THIRD DIGIT
02CD  AD34                      SHS    RL,V1,4              RIGHT JUSTIFY THIRD DIGIT
02CE  ED00 02DB                 BAL    I,RET,HEXA1          CONVERT THIRD DIGIT
02D0  AE74                      SHS    LL,V1,8              POSITION DIGIT
02D1  E043                      LDR    R,LSD,V1             PUT IN OUTPUT REGISTER
02D2  E014                      LDR    R,V1,HIN             GET HEX INPUT VALUE
02D3  A104 000F                 AND    I,V1,0F              CLEAR ALL BUT FOURTH DIGIT
02D5  ED00 02DB                 BAL    I,RET,HEXA1          CONVERT FOURTH DIGIT
02D7  8043                      ADD    R,LSD,V1             PUT IN OUTPUT REGISTER
                     .
                     . ****
                     . EXIT
                     . ****
                     .
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
02D8  E200 02E1             LDR   D,RET,HEXRTN        GET RETURN ADDRESS              532
02DA  BF07                  BRC   R,7,RET             RETURN                          533
                                                                                      534
                    . ******************                                            535
                    . CONVERT ONE DIGIT                                               536
                    . ******************                                            537
                                                                                      538
02DB  20A4          HEXA1   CMP   IS,V1,00A           COMPARE WITH HEX 'A'            539
02DC  C104 02DF             BRCL  LT,HEXA2            BRANCH IF LESS                  540
02DE  6074                  ADD   IS,V1,7             ADD 7 TO VALUE                  541
02DF  6304          HEXA2   ADD   IS,V1,030           ADD HEX '30'                    542
02E0  BF07                  BRC   R,7,RET             GO BACK TO WHERE CALLED FROM    543
                                                                                      544
                    . ****                                                            545
                    . DATA                                                            546
                    . ****                                                            547
                                                                                      548
02E1                HEXRTN  DS    1                   SAVE LOCATION FOR RETURN ADDRESS 549
                    .                                                                 550
                    .                                                                 551
                    .                                                                 552
                    .                                                                 553
                    .*****************************************************************554
                    . AHEX                                                           *555
                    .                                                                *556
                    . ROUTINE TO CONVERT FOUR (4) OR LESS DIGITS IN ASCII            *557
                    . CODE TO A TRUE HEX VALUE FOR THE MACHINE.  SIGN OF THE         *558
                    . VALUE MUST BE HANDLED BY THE CALLING ROUTINE.                  *559
                    .                                                                *560
                    . CALLING PROCEDURE:                                             *561
                    .       BAL   I,0,AHEX                                           *562
                    .                                                                *563
                    . INPUTS:                                                        *564
                    .     REG 1     ADDRESS OF FIRST CONSECUTIVE LOCATION IN         *565
                    .               CORE WHERE THE ASCII CHARACTERS ARE LOCATED      *566
                    .               (ONE CHARACTER PER CORE LOCATION)                *567
                    .                                                                *568
                    . OUTPUT:                                                        *569
                    .     REG 2     HEX VALUE                                        *570
                    .                                                                *571
                    . ROUTINES CALLED:                                               *572
                    .     NONE                                                       *573
                    .                                                                *574
                    . REGISTERS 8 THROUGH 16 ARE PRESERVED                           *575
                    .*****************************************************************576
                    .                                                                 577
                    . ******************                                            578
                    . ESTABLISH EQUATES                                               579
                    . ******************                                            580
                    .                                                                 581
AHADD               EQU   1                         ADDRESS OF ASCII CHARACTERS       582
AHOUT               EQU   2                         OUTPUT HEX VALUE                  583
AHV1                EQU   5                         VARIABLE 1                        584
```

```
LOC   OBJECT CODE      CARD IMAGE
                       AHV2     EQU   6                    VARIABLE 2
                       AHZ      EQU   7                    ZERO
                       .
                       .
                       .
                       . ********************
                       . CONVERT ASCII TO HEX
                       . ********************
                       .
02E2  4002             AHEX     LDR   IS,AHOUT,0           CLEAR REGISTER
02E3  4045                      LDR   IS,AHV1,4            SET UP COUNTER
02E4  4007                      LDR   IS,AHZ,0             SET UP ZERO REGISTER
02E5  5176             AH1      LDR   RX,AHV2,AHZ,AHADD    GET ASCII CHARACTER
02E6  2206                      CMP   IS,AHV2,020          COMPARE WITH SPACE
02E7  C102  02F7                BRCL  EQ,AH3               DON'T TRANSLATE SPACES
02E9  AE32                      SHS   LL,AHOUT,4           MOVE DIGIT OVER
02EA  2406                      CMP   IS,AHV2,040          COMPARE WITH MIN LETTER
02EB  C104  02EE                BRCL  LT,AH2               SKIP IF NUMERIC
02ED  6096                      ADD   IS,AHV2,9            INCREMENT ALPHA
02EE  A106  000F       AH2      AND   I,AHV2,0000F         CLEAR ALL BUT DIGIT
02F0  8062                      ADD   R,AHOUT,AHV2         PUT IN OUTPUT REGISTER
02F1  6FF5                      ADD   IS,AHV1,-1           DECREMENT COUNTER
02F2  C102  02F7                BRCL  Z,AH3                DONE
02F4  6011                      ADD   IS,AHADD,1           INCREMENT CHARACTER ADDRESS
02F5  C107  02E5                BRCL  U,AH1                KEEP GOING
02F7  BF07             AH3      BRC   R,7,RET              GET OUT
                       .
                       .
                       .
                       .************************************************************
                       . CORE                                                       *
                       .                                                            *
                       . ROUTINE TO CONTROL CORE INTERACTIVELY FROM THE KEYBOARD.   *
                       .                                                            *
                       .                                                            *
                       . *****WARNING*****                                          *
                       . THIS ROUTINE SHOULD ONLY BE CALLED BY 'KEYMR'. THERE ARE   *
                       . SPECIAL CONSIDERATIONS IN CALLING WHICH ARE TAKEN INTO     *
                       . ACCOUNT BY KEYMR. (TAKE SPECIAL NOTE OF REGISTER 2 WHEN    *
                       . 'CORE' IS CALLED AND THE WAY 'CORE' EXITS THROUGH 'KEYMR'*
                       .                                                            *
                       .                                                            *
                       . MAY BE INITIATED BY THE OPERATOR AT ANY TIME WHEN THE      *
                       . KEYBOARD IS ACCEPTING DATA BY TYPING 'CORE'.    ONCE       *
                       . ENTERED, IT REMAINS IN CONTROL UNTIL RELEASED BY THE       *
                       . TYPED COMMAND 'DONE'. THE COMMANDS AND FUNCTIONS ARE       *
                       . AS LISTED:                                                 *
                       .                                                            *
                       .      COMMAND                 FUNCTION                      *
                       .                                                            *
                       .      DUMP 'ADD'              PRINTS 10 LINES OF 8 VALUES   *
```

```
LOC    OBJECT CODE      CARD IMAGE                                                           CARDNUM
                    .                           OF CORE STARTING WITH THE       *
                    .                           ADDRESS SPECIFIED . 'ADD'       *
                    .                           MUST BE HEXIDECIMAL - ALPHA     *
                    .                           CHARACTERS IN UPPER CASE.       *
                    .                           'DUMP' MUST BE TYPED IN LOWER   *
                    .                           CASE LETTERS                    *
                    .                                                           *
                    .     CHANGE 'ADD' 'VALUE'  CHANGES THE CONTENTS OF THE     *
                    .                           CORE LOCATION WHOSE ADDRESS     *
                    .                           IS SPECIFIED TO THE VALUE       *
                    .                           SPECIFIED                       *
                    .                                                           *
                    .     DISPLAY 'ADD'         DISPLAYS THE CONTENTS OF THE    *
                    .                           CORE LOCATION IN 'ADD'          *
                    .                                                           *
                    .     CS 'ADD'              INITIATES THE CHANGING OF CORE*
                    .                           SEQUENTIALLY STARTING WITH THE*
                    .                           SPECIFIED ADDRESS. AFTER THIS *
                    .                           COMMAND, THE FIRST FOUR CHARA-*
                    .                           CTERS TYPED ARE PLACED IN CORE*
                    .                           AND THE ADDRESS INCREMENTED BY*
                    .                           ONE.  THE CHANGE IS TERMINATED*
                    .                           BY TYPING 'DONE'. (THIS TYPING *
                    .                           OF 'DONE' DOES NOT CAUSE THE   *
                    .                           CORE PROGRAM TO BE EXITED)      *
                    .                                                           *
                    .                                                           *
                    . CALLING PROCEDURE:                                        *
                    .        BAL    I,0,CORE                                    *
                    .                                                           *
                    . INPUTS:                                                   *
                    .     NONE                                                  *
                    .                                                           *
                    . OUTPUTS:                                                  *
                    .     NONE                                                  *
                    .                                                           *
                    . ROUTINES CALLED:                                          *
                    .     KEYMR                                                 *
                    .     OUTPUT                                                *
                    .     HEXA                                                  *
                    .     AHEX                                                  *
                    .                                                           *
                    . THIS ROUTINE PRESERVES NO REGISTERS                       *
                    .************************************************************
                    .
                    . *****************
                    . ESTABLISH EQUATES
                    . *****************
                    .
                    CADD      EQU    1                  ADDRESS OF BUFFER RETURNED
                    CHV       EQU    1                  HEX VALUE TO INPUT TO HEXA
                    CA1       EQU    2                  ASCII MSD RETURNED BY HEXA
                    CA2       EQU    3                  ASCII LSD RETURNED BY HEXA
```

```
LOC   OBJECT CODE      CARD IMAGE                                                              CARDNUM
                     CV3       EQU   5                         VARIABLE 3
                     CMAX      EQU   6                         MAX NO. CHARACTERS INPUT BY KFYMR
                     CINDX     EQU   7                         PATH FLAG
                     CFLG      EQU   8                         BLANK FLAG
                     CF2       EQU   9                         FIELD2
                     CZERO     EQU   10                        CONSTANT 0
                     CSPACE    EQU   11                        ASCII CODE FOR SPACE
                     CV1       EQU   12                        VARIABLE 1
                     CV2       EQU   13                        VARIABLE 2
                     CMD       EQU   14                        COMMAND
                     CF1       EQU   15                        FIELD 1
                     .
                     .
                     .
                     .
                     .  ******
                     .  SET UP
                     .  ******
                     .
02F8  9C02 03D3      CORE      STR   D,2,CSAVE                 SAVE REGISTER 2
02FA  400C                     LDR   IS,CV1,0                  GET A ZERO
02FB  9C0C 0412                STR   D,CV1,CSFLG               INITIALIZE SEQUENTIAL CHANGE FLAG
02FD  E101 0405      C1        LDR   I,CADD,CTITLE             GET BUFFER ADDRESS FOR TITLE
02FF  ED00 0230                BAL   I,RET,OUTPUT              OUTPUT TITLE
0301  ED00 0151                BAL   I,RET,KEYMR               GET KEYBOARD COMMAND
0303  E10B 2020                LDR   I,CSPACE,02020            SET UP SPACE CODE
0305  400A                     LDR   IS,CZERO,0                SET UP ZERO CONSTANT
0306  400E                     LDR   IS,CMD,0                  ZERO COMMAND REGISTER
0307  400F                     LDR   IS,CF1,0                  ZERO FIELD 1
0308  4009                     LDR   IS,CF2,0                  ZERO FIELD 2
0309  4008                     LDR   IS,CFLG,0                 ZERO FLAG
030A  4007                     LDR   IS,CINDX,0                ZERO PATH FLAG
                     .
                     .  *****************
                     .  TRANSLATE COMMAND
                     .  *****************
                     .
030B  51A6                     LDR   RX,CMAX,CZERO,CADD        GET NO. OF ENTRIES IN BUFFER
030C  4008           C2        LDR   IS,CFLG,0                 SET FLAG FOR READY
030D  6011           C3        ADD   IS,CADD,1                 INCREMENT BUFFER ADDRESS
030E  6FF6                     ADD   IS,CMAX,-1                DECREMENT CHARACTER COUNTER
030F  C106 0327                BRCL  NP,C6A                    DONE
0311  51AC                     LDR   RX,CV1,CZERO,CADD         GET A CHARACTER FROM THE BUFFER
0312  220C                     CMP   IS,CV1,020                COMPARE WITH SPACE
0313  C102 030C                BRCL  EQ,C2                     KEEP GOING IF SPACE
0315  2008                     CMP   IS,CFLG,0                 SEE IF IN MIDDLE OF ENTRY
0316  C105 030D                BRCL  NE,C3                     IN ENTRY, KEEP LOOKING
                     .
0318  E370 031B                LDR   DX,RET,CFLD,CINDX         GET PROCESSING ADDRESS
031A  BF07                     BRC   R,7,RET                   PROCESS ACCORDING TO FIELD FOUND
                     .
                     .  BRANCH TABLE
                     .
```

```
LOC   OBJECT CODE      CARD IMAGE                                                             CARDNUM
031B  031E            CFLD     DC     C4                        COMMAND FIELD                    744
031C  0323                     DC     C5                        FIELD 1                          745
031D  0326                     DC     C6                        FIELD 2                          746
                      .                                                                          747
                      .                                                                          748
031E  E01B            C4       LDR    R,CMD,CADD                ADDRESS OF COMMAND               749
031F  6017            C7       ADD    IS,CINDX,1                INCREMENT PATH INDEX             750
0320  4FF8                     LDR    IS,CFLG,-1                SET FLAG FOR IN ENTRY            751
0321  C107 030D                BRCL   U,C3                      KEEP GOING                       752
0323  E01F            C5       LDR    R,CF1,CADD                ADDRESS OF FIELD 1               753
0324  C107 031F                BRCL   U,C7                      KEEP GOING                       754
0326  E019            C6       LDR    R,CF2,CADD                ADDRESS OF FIELD 2               755
                      .                                                                          756
                      .                                                                          757
0327  200F            C6A      CMP    IS,CF1,0                  SEE IF FIELD 1 IS PRESENT        758
0328  C102 0335                BRCL   EQ,C8                     GO PROCESS COMMAND ONLY          759
                      .                                                                          760
                      . CONVERT FIELD 1 TO HEX                                                   761
                      .                                                                          762
032A  E0F1                     LDR    R,CADD,CF1                PUT ADDRESS IN REGISTER          763
032B  ED00 02E2                BAL    I,RET,AHEX                CONVERT VALUE                    764
032D  E02F                     LDR    R,CF1,CA1                 PUT HEX VALUE IN FIELD           765
                      .                                                                          766
                      .                                                                          767
032E  2009                     CMP    IS,CF2,0                  SEE IF FIELD 2 IS PRESENT        768
032F  C102 0335                BRCL   EQ,C8                     GO PROCESS COMMAND               769
                      .                                                                          770
                      . CONVERT FIELD 2 TO HEX                                                   771
                      .                                                                          772
0331  E091                     LDR    R,CADD,CF2                PUT ADDRESS IN REGISTER          773
0332  ED00 02E2                BAL    I,RET,AHEX                CONVERT VALUE                    774
0334  E029                     LDR    R,CF2,CA1                 PUT HEX VALUE IN FIELD           775
                      .                                                                          776
                      .                                                                          777
                      . BRANCH TO PROCESS ON COMMAND                                             778
                      .                                                                          779
0335  5EAC            C8       LDR    RX,CV1,CZERO,CMD          GET FIRST CHARACTER OF COMMAND   780
0336  601E                     ADD    IS,CMD,1                  INCREMENT ADDRESS                781
0337  5EAD                     LDR    RX,CV2,CZERO,CMD          GET SECOND CHARACTER OF COMMAND  782
0338  A10D 00FF                AND    I,CV2,000FF               CLEAR UPPER BITS                 783
033A  AE7C                     SHS    LL,CV1,8                  LEFT JUSTIFY 1ST CHARACTER       784
033B  80DC                     ADD    R,CV1,CV2                 PUT 1ST 2 CHARACTERS IN ONE WORD 785
                      .                                                                          786
033C  B10C 646F                CMP    I,CV1,0646F               COMPARE WITH 'DO'                787
033E  C102 0352                BRCL   EQ,C9                     GO PROCESS DONE                  788
                      .                                                                          789
0340  B10C 6475                CMP    I,CV1,06475               COMPARE WITH 'DU'                790
0342  C102 0356                BRCL   EQ,C10                    GO PROCESS DUMP                  791
                      .                                                                          792
0344  B10C 6469                CMP    I,CV1,06469               COMPARE WITH 'DI'                793
0346  C102 0383                BRCL   EQ,C11                    GO PROCESS DISPLAY               794
                      .                                                                          795
0348  B10C 6368                CMP    I,CV1,06368               COMPARE WITH 'CH'                796
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
034A  C102 039C             BRCL  EQ,C12          GO PROCESS 'CHANGE'                797
                                                                                     798
034C  B10C 6373             CMP   I,CV1,06373     COMPARE WITH 'CS'                  799
034E  C102 03A0             BRCL  EQ,C20          GO PROCESS CHANGE SEQUENTIAL       800
                                                                                     801
0350  C107 02FD             BRCL  U,C1            INVALID COMMAND, GO TRY AGAIN      802
                                                                                     803
                                                                                     804
                                                                                     805
                                                                                     806
                          * ****                                                     807
                          * DONE                                                     808
                          * ****                                                     809
                                                                                     810
0352  E200 03D3   C9        LDR   D,0,CSAVE       GET ADDRESS OF CALLING ROUTINE     811
0354  C107 0151             BRC   I,7,KEYMR       EXIT THROUGH KEYMR                 812
                                                                                     813
                                                                                     814
                                                                                     815
                                                                                     816
                          * ****                                                     817
                          * DUMP                                                     818
                          * ****                                                     819
                                                                                     820
0356  A10F FFF8   C10       AND   I,CF1,0FFF8     CLEAR LAST THREE BITS              821
0358  E0F5                  LDR   R,CV3,CF1       SET UP ADDRESS TO DUMP             822
0359  40A7                  LDR   IS,CINDX,10     SET UP LINE COUNTER                823
                                                                                     824
                          * OUTPUT LINE OF CORE WITH ADDRESS OF FIRST VALUE           825
                                                                                     826
035A  E10C 03D5   C13       LDR   I,CV1,CBUFF     SET UP OUTPUT BUFFER ADDRESS       827
035C  E0AD                  LDR   R,CV2,CZERO     SET UP ROW COUNTER                 828
035D  E051                  LDR   R,CADD,CV3      SET UP INPUT FOR HEXA              829
035E  ED00 02BB             BAL   I,RET,HEXA      CONVERT ADDRESS TO ASCII           830
0360  1AC2                  STR   RX,CA1,CV1,CZERO PUT MSD OF ADD IN OUTPUT BUFFER   831
0361  601C                  ADD   IS,CV1,1        INCREMENT BUFFER ADDRESS           832
0362  1AC3                  STR   RX,CA2,CV1,CZERO PUT LSD OF ADD IN OUTPUT BUFFER   833
0363  601C                  ADD   IS,CV1,1        INCREMENT BUFFER ADDRESS           834
0364  1ACB                  STR   RX,CSPACE,CV1,CZERO   PUT IN SPACES                835
0365  601C        C14       ADD   IS,CV1,1        INCREMENT BUFFER ADDRESS           836
0366  1ACB                  STR   RX,CSPACE,CV1,CZERO   PUT IN SPACES                837
0367  601C                  ADD   IS,CV1,1        INCREMENT BUFFER ADDRESS           838
0368  5A51                  LDR   RX,CADD,CV3,CZERO GET VALUE TO CONVERT             839
0369  6015                  ADD   IS,CV3,1        INCREMENT ADD OF VALUE TO OUTPUT   840
036A  ED00 02BB             BAL   I,RET,HEXA      CONVERT VALUE                      841
036C  1AC2                  STR   RX,CA1,CV1,CZERO PUT MSD OF VALUE IN OUTPUT BUFFER 842
036D  601C                  ADD   IS,CV1,1        INCREMENT BUFFER ADDRESS           843
036E  1AC3                  STR   RX,CA2,CV1,CZERO PUT LSD OF VALUE IN OUTPUT BUFFER 844
036F  601D                  ADD   IS,CV2,1        INCREMENT ROW COUNTER              845
0370  208D                  CMP   IS,CV2,8        COMPARE WITH LAST VALUE            846
0371  C102 0375             BRCL  EQ,C15          BRANCH IF EQUAL                    847
0373  C107 0365             BRCL  U,C14           GO DO ANOTHER VALUE                848
0375  E101 03D5   C15       LDR   I,CADD,CBUFF    GET BUFFER POINTER                 849
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
0377  6FF1            ADD   IS,CADD,-1      DECREMENT BY ONE TO GET COUNT             850
0378  9CF0 03F1       STRM  D,0,CS1,16      SAVE REGISTERS                            851
037A  ED00 0230       BAL   I,RET,OUTPUT    OUTPUT ONE LINE                           852
037C  BCF0 03F1       LDRM  D,0,CS1,16      RESTORE REGISTERS                         853
037E  6FF7            ADD   IS,CINDX,-1     DECREMENT LINE COUNTER                    854
037F  C105 035A       BRCL  NZ,C13          DO ANOTHER LINE                           855
0381  C107 02FD       BRC   I,1,C1          WAIT FOR ANOTHER COMMAND                  856
                                                                                      857
                                                                                      858
                                                                                      859
                                                                                      860
                      *******                                                         861
                      DISPLAY                                                         862
                      *******                                                         863
                                                                                      864
0383  E0F1      C11   LDR   R,CADD,CF1      GET ADD OF LOCATION TO DISPLAY            865
0384  ED00 02BB       BAL   I,RET,HEXA      CONVERT CORE CONTENTS TO ASCII            866
0386  9C02 040A       STR   D,CA1,CBUD1     PUT MSD IN OUTPUT BUFFER                  867
0388  9C03 040B       STR   D,CA2,CBUD1+1   PUT LSD IN OUTPUT BUFFER                  868
038A  E3F1 0000       LDR   DX,CADD,0,CF1   PUT CORE VALUE IN REGISTER                869
038C  ED00 02BB       BAL   I,RET,HEXA      CONVERT ADDRESS TO ASCII                  870
038E  9C02 040D       STR   D,CA1,CBUD2     PUT MSD IN OUTPUT BUFFER                  871
0390  9C03 040E       STR   D,CA2,CBUD2+1   PUT LSD IN OUTPUT BUFFER                  872
0392  E101 0409       LDR   I,CADD,CBUD     PUT ADDRESS IN REGISTER                   873
0394  ED00 0230       BAL   I,RET,OUTPUT    OUTPUT BUFFER TO CRT                      874
0396  E20F 0412       LDR   D,CF1,CSFLG     GET FLAG FOR SEQUENTIAL CHANGE            875
0398  C105 03C5       BRCL  NZ,C23          GO BACK TO SEQUENTIAL IF FLAG SET         876
039A  C107 02FD       BRC   I,1,C1          GO AGAIN                                  877
                                                                                      878
                                                                                      879
                                                                                      880
                                                                                      881
                      ******                                                          882
                      CHANGE                                                          883
                      ******                                                          884
                                                                                      885
039C  9BF9 0000   C12 STR   DX,CF2,0,CF1    CHANGE CORE CONTENTS                      886
039E  C107 0383       BRC   I,1,C11         GO DISPLAY CORE CHANGE                    887
                                                                                      888
                                                                                      889
                                                                                      890
                      PAGE                                                            891
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                    CARDNUM

                      .
                      . ************************
                      . CHANGE CORE SEQUENTIALLY
                      . ************************
                      .
03A0  9C0F 0410       C20      STR    D,CF1,CSTRT          SAVE START OF CORE CHANGE
03A2  9C0F 0411                STR    D,CF1,CSTOR          SAVE ADDRESS AT WHICH TO STORE
03A4  401C                     LDR    IS,CV1,1             SET UP A CONSTANT 1
03A5  9C0C 0412                STB    D,CV1,CSFLG          SET FLAG FOR SEQUENTIAL CHANGE
03A7  ED00 0151       C21      BAL    I,RET,KEYMR          GET VALUE FOR CORE
03A9  400A                     LDR    IS,CZERO,0           SET UP ZERO REGISTER
03AA  6011                     ADD    IS,CADD,1            INCREMENT BUFFER POINTER
03AB  4015                     LDR    IS,CV3,1             SET UP A CONSTANT 1
03AC  51AC                     LDR    RX,CV1,CZERO,CADD    GET FIRST CHARACTER ENTERED
03AD  515D                     LDR    RX,CV2,CV3,CADD      GET SECOND CHARACTER ENTERED
03AE  AE7C                     SHS    LL,CV1,8             LEFT JUSTIFY FIRST CHARACTER
03AF  AE7D                     SHS    LL,CV2,8             CLEAR UPPER 8 BITS OF SECOND CHAR
03B0  AD7D                     SHS    RL,CV2,8             RIGHT JUSTIFY SECOND CHARACTER
03B1  80DC                     ADD    R,CV1,CV2            COMBINE BOTH CHARACTERS
03B2  B10C 646F                CMP    I,CV1,0646F          COMPARE WITH 'DO'
03B4  C102 03C1                BRCL   EQ,C22               GET OUT IF DONE
03B6  ED00 02E2                BAL    I,RET,AHEX           CONVERT ENTRY TO HEX
03B8  E20F 0411                LDR    D,CF1,CSTOR          GET ADDRESS FOR STORING
03BA  9BF2 0000                STR    DX,CA1,0,CF1         PUT VALUE IN CORE
03BC  601F                     ADD    IS,CF1,1             INCREMENT STORE ADDRESS
03BD  9C0F 0411                STR    D,CF1,CSTOR          SAVE NEW STORE ADDRESS
03BF  C107 03A7                BRCL   U,C21                GO GET ANOTHER ENTRY
03C1  E20F 0410       C22      LDR    D,CF1,CSTRT          GET ADDRESS OF FIRST CORE CHANGED
03C3  C107 0383                BRCL   U,C11                GO DISPLAY LOCATION
03C5  E20C 0410       C23      LDR    D,CV1,CSTRT          GET ADDRESS DISPLAYED
03C7  601C                     ADD    IS,CV1,1             INCREMENT ADDRESS
03C8  9C0C 0410                STR    D,CV1,CSTRT          SAVE AS NEW DISPLAY ADDRESS
03CA  B20C 0411                CMP    D,CV1,CSTOR          COMPARE WITH LAST ADDRESS+1
03CC  C104 03C1                BRCL   LT,C22               DO AGAIN IF NOT FINISHED
03CE  400C                     LDR    IS,CV1,0             GET A ZERO
03CF  9C0C 0412                STR    D,CV1,CSFLG          CLEAR SEQUENTIAL FLAG
03D1  C107 02FD                BRCL   U,C1                 GO GET ANOTHER COMMAND
                      .
                      .
                      .
                      . ****************
                      . DATA AND BUFFERS
                      . ****************
                      .
03D3                  CSAVE    DS     1                    ADDRESS OF ROUTINE CALLING CORE
                      .
                      .
03D4  001C            CBCNT    DC     28                   COUNT OF VALUES IN BUFFER TO OUTPUT
03D5                  CBUFF    DS     27                   OUTPUT BUFFER
03F0  0D0A                     DC     00D0A                CR/LF
                      .
                      .
```

```
LOC   OBJECT CODE     CARD IMAGE                                                  CARDNUM
03F1                  CS1       DS    20        REG SAVE AREA FOR INTERNAL USE      945
                      .                                                           946
                      .                                                           947
0405  0003            CTITLE    DC    3         COUNT                             948
0406  0D0A                      DC    00D0A     CR/LF                             949
0407  434F                      DC    0434F     CO                                950
0408  5245                      DC    05245     RE                                951
                      .                                                           952
0409  0006            CBUD      DC    6         COUNT                             953
040A                  CBUD1     DS    2         2 LOCATIONS FOR ADDRESS           954
                      .                                                           955
040C  2020                      DC    02020     BLANKS                            956
040D                  CBUD2     DS    2         2 LOCATIONS FOR CONTENTS          957
040F  0D0A                      DC    00D0A     CR/LF                             958
                      .                                                           959
0410  0000            CSTRT     DC    0         START ADDRESS FOR SEQUENTIAL CORE 960
0411  0000            CSTOR     DC    0         CURRENT ADDRESS FOR STORING IN SEQ 961
0412  0000            CSFLG     DC    0         FLAG FOR SEQUENTIAL CHANGE        962
                      .                                                           963
                      .                                                           964
                      .                                                           965
                                END                                               966
```

```
ATAC                                                                    TIME: 16:43:42     03/18/77     PAGE    1
LOC   OBJECT CODE      CARD IMAGE                                                                    CARDNUM
                                     IDT    ATAC
0000                                 DS     0500
                                     ENTRY  WJ
                       .
                       RET           EQU    0
                       OUTPUT        EQU    00230
                       KEYMR         EQU    00151
                       .
                       .
                       .  *****************
                       .  ESTABLISH EQUATES
                       .  *****************
                       .
                       WJXS          EQU    1                   XAR START
                       WJXE          EQU    2                   XAR END
                       WJX1          EQU    3                   XAR 1
                       WJX2          EQU    4                   XAR 2
                       WJX3          EQU    5                   XAR 3
                       WJX4          EQU    6                   XAR 4
                       WJD1          EQU    7                   DATA 1
                       WJD2          EQU    8                   DATA 2
                       WJD3          EQU    9                   DATA 3
                       WJD4          EQU    10                  DATA 4
                       WJXX          EQU    11                  XAR FOR CHECK
                       WJV1          EQU    1                   VARIABLE 1
                       WJV2          EQU    2                   VARIABLE 2
                       WJV3          EQU    3                   VARIABLE 3
                       WJV4          EQU    4                   VARIABLE 4
                       WJV5          EQU    5                   VARIABLE 5
                       WJV6          EQU    6                   VARIABLE 6
                       WJV7          EQU    7                   VARIABLE 7
                       WJV8          EQU    8                   VARIABLE 8
                       WJV9          EQU    9                   VARIABLE 9
                       WJV10         EQU    10                  VARIABLE 10
                       WJV11         EQU    11                  VARIABLE 11
                       WJLPC         EQU    15                  WJS COUNTER
                       .
                       .
                       .
                       .
                       .  *****
                       .  ENTRY
                       .  *****
                       .
0500  9C00 09AD        WJ            STR    D,RET,WJRET         SAVE RETURN ADDRESS
                       .
                       .  *******************
                       .  INITIALIZE RECEIVER
                       .  *******************
                       .
0502  BC31 09BC        WJ01          LDRM   D,WJV1,WJI1,4       GET INITIAL CONTROL WORDS FOR RCVR
0504  9C31 09C8                      STRM   D,WJV1,WJCW1,4      PUT INITIAL VALUES INTO CONTROL
0506  BC71 09C0                      LDRM   D,WJV1,WJICD,8      GET INITIAL CONTROL WORD DISPLAY
0508  9C71 09D8                      STRM   D,WJV1,WJCFL,8      SAVE INITIAL CONTROL WORD DISPLAY
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
050A  E603 09BB             LLC   D,WJX1,WJCRO       LOAD "ADDRESS ON"                 55
050C  D932                  ROUT  02,WJX1            ENABLE RECEIVER/TURN ON INTERFACE 56
050D  E101 0000             LDR   I,WJXS,0           CLEAR REGISTER                    57
050F  9C01 09F4             STR   D,WJXS,CHKFLG1     CLEAR FLAG                        58
0511  9C01 09F6             STR   D,WJXS,WJLPK       ZERO WJS COUNTER                  59
0513  ED00 08AE             BAL   I,RET,WJS          SEND INITIAL CONTROL WORD TO RCVR 60
0515  E101 0A02             LDR   I,WJV1,WJINS       GET ADDRESS OF INSTRUCTION BUFFER 61
0517  ED00 0230             BAL   I,RET,OUTPUT       OUTPUT INSTRUCTIONS TO CRT        62
0519  E101 09F7  WJ02       LDR   I,WJV1,WJT         GET ADDRESS OF TITLE BUFFER       63
051B  ED00 07AE             BAL   I,RET,WJ90         OUTPUT TITLE AND GET ENTRY        64
051D  C107 0519             BRCL  U,WJ02             ILLEGAL ENTRY                     65
                                                                                       66
                      . ******************                                           67
                      . TRANSLATE COMMAND                                            68
                      . ******************                                           69
                      .                                                              70
051F  2012                  CMP   IS,WJV2,1          COMPARE WITH ONE                  71
0520  C105 0519            BRCL  NE,WJ02            WILL ONLY ACCEPT ONE CHAR         72
0522  2083                  CMP   IS,WJV3,8          COMPARE WITH MAX VALUE            73
0523  C101 0519             BRCL  GT,WJ02            ENTRY OUT OF RANGE                74
                      .                                                              75
                      . ****************************                                 76
                      . BRANCH ACCORDING TO COMMAND                                  77
                      .****************************                                 78
                      .                                                              79
0525  E330 0528             LDR   DX,RET,WJBRC,WJV3  GET ADDRESS FOR BRANCH FROM TABLE 80
0527  BF07                  BRC   R,7,RET            GO PROCESS ACCORDING TO COMMAND   81
                      .                                                              82
                      . BRANCH TABLE FOR COMMANDS FROM OPERATOR                      83
                      .                                                              84
0528  0531        WJBRC     DC    WJ10               0=SET UP TENTATIVE WORD           85
0529  05AE                  DC    WJ20               1=DISPLAY TENTATIVE CONTROL WORD  86
052A  05C6                  DC    WJ30               2=DISPLAY CONTROL WORD            87
052B  05DE                  DC    WJ40               3=DISPLAY LAST RECEIVED WORD      88
052C  0614                  DC    WJ50               4=ENTER TENTATIVE WORD AS NEW CONTRO 89
052D  0657                  DC    WJ60               5=SCAN                            90
052E  C790                  DC    WJ70               6=RECEIVE CONTROL WORD FROM RCVR  91
052F  C7A8                  DC    WJ80               7=DONE                            92
0530  C502                  DC    WJ01               8=REINITIALIZE                    93
                      .                                                              94
                      .                                                              95
                      .                                                              96
                      .                                                              97
                      . ******************                                           98
                      . SET UP (COMMAND=0)                                           99
                      . ******************                                          100
                      .                                                             101
                      . OUTPUT TITLE AND GET KEYBOARD ENTRY FOR FREQUENCY           102
                      .                                                             103
0531  E101 0A4B   WJ10      LDR   I,WJV1,WJFB        GET ADDRESS OF FREQUENCY TITLE   104
0533  ED00 07AE             BAL   I,RET,WJ90         OUTPUT TITLE AND GET ENTRY       105
0535  C107 0531             BRCL  U,WJ10             ILLEGAL ENTRY                    106
0537  ED00 07CC             BAL   I,RET,WJ91         MAKE SURE FREQUENCY IS LEGAL     107
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LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
0539  C107 0531             BRCL  U,WJ10          ILLEGAL FREQUENCY                    108
053B  9C03 09D0             STR   D,WJV3,WJTFL    STORE TENTATIVE FREQUENCY (LOWER)    109
053D  9C04 09D1             STR   D,WJV4,WJTFU    STORE TENTATIVE FREQUENCY (UPPER)    110
                      :                                                               111
                      : OUTPUT TITLE AND GET KEYBOARD ENTRY FOR DETECT MODE           112
                      :                                                               113
053F  E101 0A89 WJ11  LDR   I,WJV1,WJDMB    GET ADDRESS OF DETECT MODE TITLE     114
0541  ED00 07AE       BAL   I,RET,WJ90      OUTPUT TITLE AND GET ENTRY           115
0543  C107 053F       BRCL  U,WJ11          ILLEGAL ENTRY                        116
0545  2073            CMP   IS,WJV3,7       COMPARE WITH MAX VALUE               117
0546  C101 053F       BRCL  GT,WJ11         TOO LARGE                            118
0548  9C03 09D2       STR   D,WJV3,WJTDM    SAVE TENTATIVE DETECT MODE           119
054A  E101 0004       LDR   I,WJV1,04       GET UPPER OF DEFAULT BFO FREQUENCY   120
054C  9C01 09D4       STR   D,WJV1,WJTBU    SAVE TENTATIVE BFO FREQUENCY (UPPER) 121
054E  E101 5500       LDR   I,WJV1,05500    GET LOWER OF DEFAULT BFO FREQUENCY   122
0550  9C01 09D3       STR   D,WJV1,WJTBL    SAVE TENTATIVE BFO FREQUENCY (LOWER) 123
0552  2033            CMP   IS,WJV3,3       COMPARE DETECT MODE WITH BFO VARIABL 124
0553  C105 056E       BRCL  NE,WJ13         NOT VARIABLE BFO, USE DEFAULT FREQUE 125
                      :                                                               126
                      : OUTPUT TITLE AND GET KEYBOARD ENTRY FOR BFO FREQUENCY         127
                      :                                                               128
0555  E101 0AB3 WJ12  LDR   I,WJV1,WJBFB    GET ADDRESS OF BFO FREQUENCY TITLE   129
0557  ED00 07AE       BAL   I,RET,WJ90      OUTPUT TITLE AND GET ENTRY           130
0559  C107 0555       BRCL  U,WJ12          ILLEGAL ENTRY                        131
055B  2062            CMP   IS,WJV2,6       COMPARE WITH EXACT COUNT             132
055C  C105 0555       BRCL  NE,WJ12         WRONG COUNT                          133
055E  E833            SHD   RL,WJV3,4       POSITION FREQUENCY (10 HZ RES)       134
055F  2044            CMP   IS,WJV4,04      COMPARE UPPER WITH EXACT VALUE       135
0560  C105 0555       BRCL  NE,WJ12         ILLEGAL ENTRY                        136
0562  B103 4500       CMP   I,WJV3,04500    COMPARE LOWER WITH MIN VALUE         137
0564  C104 0555       BRCL  LT,WJ12         ILLEGAL ENTRY                        138
0566  B103 6500       CMP   I,WJV3,06500    COMPARE LOWER WITH MAX VALUE         139
0568  C101 0555       BRCL  GT,WJ12         ILLEGAL ENTRY                        140
056A  9C03 09D3       STR   D,WJV3,WJTBL    SAVE TENTATIVE BFO FREQUENCY (LOWER) 141
056C  9C04 09D4       STR   D,WJV4,WJTBU    SAVE TENTATIVE BFO FREQUENCY (UPPER) 142
                      :                                                               143
                      : OUTPUT TITLE AND GET KEYBOARD ENTRY FOR GAIN MODE             144
                      :                                                               145
056E  E101 0A53 WJ13  LDR   I,WJV1,WJGMB    GET ADDRESS OF GAIN MODE TITLE       146
0570  ED00 07AE       BAL   I,RET,WJ90      OUTPUT TITLE AND GET ENTRY           147
0572  C107 056E       BRCL  U,WJ13          ILLEGAL ENTRY                        148
0574  2033            CMP   IS,WJV3,3       COMPARE WITH MAX VALUE               149
0575  C101 056E       BRCL  GT,WJ13         ILLEGAL ENTRY                        150
0577  2013            CMP   IS,WJV3,1       COMPARE WITH ENTRY FO 1              151
0578  C102 056E       BRCL  EQ,WJ13         ILLEGAL ENTRY                        152
057A  E201 09D2       LDR   D,WJV1,WJTDM    GET TENTATIVE DETECT MODE            153
057C  2041            CMP   IS,WJV1,4       COMPARE WITH ISB                     154
057D  C105 0582       BRCL  NE,WJ131        BRANCH IF NOT ISB                    155
057F  2003            CMP   IS,WJV3,0       MAKE SURE GAIN MODE NOT HOLD AGC     156
0580  C102 056E       BRCL  EQ,WJ13         ILLEGAL ENTRY                        157
0582  9C03 09D5 WJ131 STR   D,WJV3,WJTGM    SAVE TENTATIVE GAIN MODE             158
                      :                                                               159
                      : OUTPUT TITLE AND GET KEYBOARD ENTRY FOR IF BANDWIDTH          160
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LOC   OBJECT CODE     CARD IMAGE                                                          CARDNUM
                      .
0584  E201 09D2                LDR   D,WJV1,WJTDM        GET TENTATIVE DETECT MODE
0586  2041                     CMP   IS,WJV1,4           COMPARE WITH ISE
0587  C104 058F                BRCL  LT,WJ14             NOT SIDEBAND-BRANCH
0589  2061                     CMP   IS,WJV1,6           COMPARE WITH USE
058A  C101 058F                BRCL  GT,WJ14             NOT SIDEBAND-BRANCH
058C  4043                     LDR   IS,WJV3,4           LOAD DEFAULT IF BANDWIDTH
058D  C107 059B                BRCL  U,WJ141             SKIP IF BANDWIDTH
058F  E101 0A6D       WJ14     LDR   I,WJV1,WJIFB        GET ADDRESS OF IF BANDWIDTH TITLE
0591  ED00 07AE                BAL   I,RET,WJ90          OUTPUT TITLE AND GET ENTRY
0593  C107 058F                BRCL  U,WJ14              ILLEGAL ENTRY
0595  2043                     CMP   IS,WJV3,4           COMPARE WITH MAX VALUE
0596  C101 058F                BRCL  GT,WJ14             ILLEGAL ENTRY
0598  2013                     CMP   IS,WJV3,1           COMPARE WITH MIN VALUE
0599  C104 058F                BRCL  LT,WJ14             ILLEGAL ENTRY
059B  9C03 09D7       WJ141    STR   D,WJV3,WJTIF        SAVE TENTATIVE IF BANDWIDTH
                      .
                      . OUTPUT TITLE AND GET KEYBOARD ENTRY FOR RF GAIN
                      .
059D  E101 0ACA       WJ15     LDR   I,WJV1,WJRFGB       GET ADDRESS OF RF GAIN TITLE
059F  ED00 07AE                BAL   I,RET,WJ90          OUTPUT TITLE AND GET ENTRY
05A1  C107 059D                BRCL  U,WJ15              ILLEGAL ENTRY
05A3  2032                     CMP   IS,WJV2,3           COMPARE WITH MAX COUNT
05A4  C101 059D                BRCL  GT,WJ15             ILLEGAL ENTRY
05A6  B103 0100                CMP   I,WJV3,0100         COMPARE WITH MAX VALUE
05A8  C101 059D                BRCL  GT,WJ15             ILLEGAL ENTRY
05AA  9C03 09D6                STR   D,WJV3,WJTRFG       SAVE TENTATIVE RF GAIN
                      .
05AC  C107 0519                BRCL  U,WJ02              GO GET ANOTHER COMMAND
                      .
                      .
                      .
                      .
                      . ********************************************
                      . DISPLAY TENTATIVE CONTROL WORD (COMMAND=1)
                      . ********************************************
                      .
05AE  E202 09D1       WJ20     LDR   D,WJV2,WJTFU        GET UPPER OF TENTATIVE FREQUENCY
05E0  E201 09D0                LDR   D,WJV1,WJTFL        GET LOWER OF TENTATIVE FREQUENCY
05E2  ED00 07D9                BAL   I,RET,WJ92          PUT FREQUENCY IN BUFFER AND DISPLAY
05E4  E201 09D5                LDR   D,WJV1,WJTGM        GET TENTATIVE GAIN MODE
05E6  E202 09D7                LDR   D,WJV2,WJTIF        GET TENTATIVE IF BANDWIDTH
05E8  ED00 0801                BAL   I,RET,WJ93          OUTPUT GAIN MODE AND IF BANDWIDTH
05EA  E201 09D2                LDR   D,WJV1,WJTDM        GET TENTATIVE DETECT MODE
05EC  E202 09D3                LDR   D,WJV2,WJTBL        GET TENTATIVE BFO FREQUENCY (LOWER)
05EE  ED00 0820                BAL   I,RET,WJ94          OUTPUT DETECT MODE AND BFO FREQUENCY
05C0  E201 09D6                LDR   D,WJV1,WJTRFG       GET TENTATIVE RF GAIN
05C2  ED00 084A                BAL   I,RET,WJ95          OUTPUT RF GAIN
05C4  C107 0519                BRCL  U,WJ02              DONE
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AD-A039 950 NAVAL POSTGRADUATE SCHOOL MONTEREY CALIF F/G 9/2
AN INTERACTIVE COMPUTER INTERFACE WITH A DIGITAL RECEIVER.(U)
MAR 77 W G BORRIES

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2 OF 2
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A039 950

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LOC   OBJECT CODE     CARD IMAGE                                                                CARDNUM
                      . **********************************
                      . DISPLAY CONTROL WORD (COMMAND=2)
                      . **********************************
                      .
05C6  E202 09D9       WJ30      LDR   D,WJV2,WJCFU       GET UPPER OF CONTROL FREQUENCY
05C8  E201 09D8                 LDR   D,WJV1,WJCFL       GET LOWER OF CONTROL FREQUENCY
05CA  ED00 07D9                 BAL   I,RET,WJ92         OUTPUT FREQUENCY
05CC  E201 09DD                 LDR   D,WJV1,WJCGM       GET CONTROL GAIN MODE
05CE  E202 09DF                 LDR   D,WJV2,WJCIF       GET CONTROL IF BANDWIDTH
05D0  ED00 0801                 BAL   I,RET,WJ93         OUTPUT GAIN MODE AND IF BANDWIDTH
05D2  E201 09DA                 LDR   D,WJV1,WJCDM       GET CONTROL DETECT MODE
05D4  E202 09DB                 LDR   D,WJV2,WJCBL       GET CONTROL BFO FREQUENCY (LOWER)
05D6  ED00 0820                 BAL   I,RET,WJ94         OUTPUT DETECT MODE AND BFO FREQUENCY
05D8  E201 09DE                 LDR   D,WJV1,WJCRFG      GET CONTROL RF GAIN
05DA  ED00 084A                 BAL   I,RET,WJ95         OUTPUT RF GAIN
05DC  C107 0519                 BRCL  U,WJ02             DONE
                      .
                      .
                      .
                      .
                      . **********************************
                      . DISPLAY RECEIVED WORD (COMMAND=3)
                      . **********************************
                      .
05DE  E202 09E1       WJ40      LDR   D,WJV2,WJRFU       GET UPPER OF RECEIVED FREQUENCY
05E0  E201 09E0                 LDR   D,WJV1,WJRFL       GET LOWER OF RECEIVED FREQUENCY
05E2  ED00 07D9                 BAL   I,RET,WJ92         OUTPUT FREQUENCY
05E4  E201 09E5                 LDR   D,WJV1,WJRGM       GET RECEIVED GAIN MODE
05E6  E202 09E7                 LDR   D,WJV2,WJRIF       GET RECEIVED IF BANDWIDTH
05E8  ED00 0801                 BAL   I,RET,WJ93         OUTPUT GAIN MODE AND IF BANDWIDTH
05EA  E201 09E2                 LDR   D,WJV1,WJRDM       GET RECEIVED DETECT MODE
05EC  E202 09E3                 LDR   D,WJV2,WJRBL       GET RECEIVED BFO FREQUENCY (LOWER)
05EE  ED00 0820                 BAL   I,RET,WJ94         OUTPUT DETECT MODE AND BFO FREQUENCY
05F0  E201 09E6                 LDR   D,WJV1,WJRRFG      GET RECEIVED RF GAIN
05F2  ED00 084A                 BAL   I,RET,WJ95         OUTPUT RF GAIN
05F4  E201 09E9                 LDR   D,WJV1,WJRSS       GET RECEIVED SIGNAL STRENGTH
05F6  4002                      LDR   IS,WJV2,0          CLEAR REGISTER
05F7  F871                      SHD   LL,WJV1,8          POSITION 1ST DIGIT
05F8  A502 2030                 IOR   I,WJV2,02030       CONVERT TO ASCII
05FA  9C02 0B22                 STR   D,WJV2,WJDSS1      STORE IN OUTPUT BUFFER
05FC  4002                      LDR   IS,WJV2,0          CLEAR REGISTER
05FD  F831                      SHD   LL,WJV1,4          POSITION LAST 2 DIGITS
05FE  AE32                      SHS   LL,WJV2,4
05FF  F831                      SHD   LL,WJV1,4
0600  A502 3030                 IOR   I,WJV2,03030       CONVERT TO ASCII
0602  9C02 0B23                 STR   D,WJV2,WJDSS1+1    STORE IN OUTPUT BUFFER
0604  E101 0B18                 LDR   I,WJV1,WJDSS       GET ADDRESS OF BUFFER TO OUTPUT
0606  ED00 0230                 BAL   I,RET,OUTPUT       OUTPUT BUFFER
0608  C107 0519                 BRCL  U,WJ02             DONE
060A                            DS    10                 SPACE FOR PATCHES
                      .
                      .
                      .
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LOC   OBJECT CODE    CARD IMAGE                                                                      CARDNUM
                     .  ************************************************
                     .  ENTER TENTATIVE CONTROL WORD (COMMAND=4)
                     .  ************************************************
                     .
0614  BC71 09D0      WJ50     LDRM  D,WJV1,WJTFL,8        GET TENTATIVE VALUES IN DISPLAY FORM
0616  9C71 09D8               STRM  D,WJV1,WJCPL,8        STORE IN CONTROL VALUES IN DISPLAY F
0618  F831                    SHD   LL,WJV1,4             POSITION FREQUENCY
0619  9C02 09C8               STR   D,WJV2,WJCW1          SET UP CONTROL WORD 1
061B  AE16                    SHS   LL,WJV6,2             POSITION GAIN MODE
061C  A461                    IOR   R,WJV1,WJV6           PUT IN CW 2
061D  E082                    LDR   R,WJV2,WJV8           GET IF BANDWIDTH
061E  AD02                    SHS   RL,WJV2,1             POSITION BANDWIDTH
061F  A421                    IOR   R,WJV1,WJV2           PUT IN CW 2
0620  9C01 09C9               STR   D,WJV1,WJCW2          STORE CONTROL WORD 2
0622  E081                    LDR   R,WJV1,WJV8           GET IF BANDWIDTH
0623  AEE1                    SHS   LL,WJV1,15            POSITION LAST DIGIT OF BANDWIDTH
0624  AEB3                    SHS   LL,WJV3,12            POSITION DETECT MODE
0625  A431                    IOR   R,WJV1,WJV3           PUT DETECT MODE IN CW 3
0626  9C01 09CA               STR   D,WJV1,WJCW3          SAVE CW 3
0628  E042                    LDR   R,WJV2,WJV4           GET BFO LOWER VALUE
0629  ED00 098E               BAL   I,RET,WJBCDH          CONVERT BCD VALUE TO HEX
062B  E501 1194               SUB   I,WJV1,4500           SUBTRACT 4500 FROM VALUE
062D  CD01 07FF               MUL   I,WJV1,07FF           MULTIPLY BY 7FF
062F  E103 07D0               LDR   I,WJV3,2000           SET UP DIVISOR
0631  8101 0373               ADD   I,WJV1,0373           ROUND
0633  FC31                    DIV   R,WJV1,WJV3           DIVIDE
0634  E023                    LDR   R,WJV3,WJV2           EXCHANGE REGISTERS
0635  F201 09CA      WJ503    LDR   D,WJV1,WJCW3          GET REST OF CW 3
0637  A431                    IOR   R,WJV1,WJV3           GET BFO FREQUENCY INTO CW 3
0638  9C01 09CA               STR   D,WJV1,WJCW3          STORE CONTROL WORD 3
063A  E202 09D6               LDR   D,WJV2,WJTRFG         GET RF GAIN VALUE
063C  ED00 098E               BAL   I,RET,WJBCDH          CONVERT BCD TO HEX
063E  CD01 007F               MUL   I,WJV1,07F            MULTIPLY BY 7F
0640  6321                    ADD   IS,WJV1,032           ROUND
0641  4643                    LDR   IS,WJV3,064           SET UP DIVISOR
0642  FC31                    DIV   R,WJV1,WJV3           DIVIDE
0643  B421                    LLC   R,WJV1,WJV2           GET VALUE COMPLEMENTED FOR WJ
0644  A101 007F               AND   I,WJV1,07F            CLEAR ALL BUT VALUE WANTED
0646  AE71                    SHS   LL,WJV1,8             POSITION RF GAIN
0647  9C01 09CB               STR   D,WJV1,WJCW4          STORE CONTROL WORD 4
0649  ED00 08AE               BAL   I,RET,WJS             OUTPUT CONTROL WORD TO WJ
064B  C107 0519               BRCL  U,WJ02                DONE
064D                          DS    10                    SPACE FOR PATCHES
                     .
                     .
                     .
                     .  ****************
                     .  SCAN (CCMMAND=5)
                     .  ****************
0657  4001           WJ60     LDR   IS,WJV1,0             CLEAR REGISTER
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LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
0658  9C01 09F0           STR   D,WJV1,WJSCNT       INITIALIZE PASS COUNT            320
065A  E101 0B97           LDR   I,WJV1,WJSCAN       GET ADDRESS OF SCAN TITLE        321
065C  ED00 0230           BAL   I,RET,OUTPUT        OUTPUT SCAN TITLE                322
065E                      DS    10                  SPACE FOR PATCHES                323
                     .                                                               324
                     . OUTPUT TITLE AND GET LOWER FREQUENCY LIMIT                    325
                     .                                                               326
0668  E101 0B9C  WJ601    LDR   I,WJV1,WJSFS        GET ADDRESS OF START FREQUENCY TITLE 327
066A  ED00 07AE           BAL   I,RET,WJ90          OUTPUT TITLE AND GET ENTRY       328
066C  C107 0668           BRCL  U,WJ601             ILLEGAL ENTRY                    329
066E  ED00 07CC           BAL   I,RET,WJ91          MAKE SURE FREQ IS IN LEGAL BOUNDS 330
0670  C107 0668           BRCL  U,WJ601             ILLEGAL ENTRY                    331
0672  9C03 09ED           STR   D,WJV3,WJSFLL       SAVE LOWER LIMIT (LOWER)         332
0674  9C04 09EC           STR   D,WJV4,WJSFLU       SAVE LOWER LIMIT (UPPER)         333
0676                      DS    10                  SPACE FOR PATCHES                334
                     .                                                               335
                     . OUTPUT TITLE AND GET UPPER FREQUENCY LIMIT                    336
                     .                                                               337
0680  E101 0BA7  WJ602    LDR   I,WJV1,WJSFE        GET ADDRESS OF END FREQ TITLE    338
0682  ED00 07AE           BAL   I,RET,WJ90          OUTPUT TITLE AND GET ENTRY       339
0684  C107 0680           BRCL  U,WJ602             ILLEGAL ENTRY                    340
0686  ED00 07CC           BAL   I,RET,WJ91          MAKE SURE FREQ IS IN LEGAL BOUNDS 341
0688  C107 0680           BRCL  U,WJ602             ILLEGAL ENTRY                    342
068A  9C03 09EB           STR   D,WJV3,WJSFUL       SAVE UPPER LIMIT (LOWER)         343
068C  9C04 09EA           STR   D,WJV4,WJSFUU       SAVE UPPER LIMIT (UPPER)         344
068E                      DS    10                  SPACE FOR PATCHES                345
                     .                                                               346
                     . MAKE SURE UPPER LIMIT GREATER THAN LOWER LIMIT                347
                     .                                                               348
0698  E205 09EC           LDR   D,WJV5,WJSFLU       GET LOWER LIMIT (UPPER)          349
069A  B054                CMP   R,WJV4,WJV5         COMPARE UPPER AND LOWER LIMITS' (UPPE 350
069B  C104 0668           BRCL  LT,WJ601            UPPER LIMIT LESS THAN LOWER      351
069D  C101 06AE           BRCL  GT,WJ603            NO NEED TO CHECK FURTHER         352
069F  E205 09ED           LDR   D,WJV5,WJSFLL       GET LOWER LIMIT (LOWER)          353
06A1  B053                CMP   R,WJV3,WJV5         COMPARE UPPER AND LOWER LIMITS (LOWE 354
06A2  C106 0668           BRCL  LE,WJ601            LESS OR EQUAL, TRY AGAIN         355
06A4                      DS    10                  SPACE FOR PATCHES                356
                     .                                                               357
                     . OUTPUT TITLE AND GET FREQUENCY INCREMENT (8000HZ MAX)         358
                     .                                                               359
06AE  E101 0BB1  WJ603    LDR   I,WJV1,WJSFI        GET ADDRESS OF FREQ INC TITLE    360
06E0  ED00 07AE           BAL   I,RET,WJ90          OUTPUT TITLE AND GET ENTRY       361
06E2  C107 06AE           BRCL  U,WJ603             ILLEGAL ENTRY                    362
06E4  E833                SHD   RL,WJV3,4           POSITION INCREMENT               363
06E5  2042                CMP   IS,WJV2,4           COMPARE COUNT WITH MAX           364
06E6  C101 06AE           BRCL  GT,WJ603            ILLEGAL - TOO LARGE              365
06E8  B103 0800           CMP   I,WJV3,0800         COMPARE WITH MAX INCREMENT       366
06EA  C101 06AE           BRCL  GT,WJ603            ILLEGAL - TOO LARGE              367
06EC  2013                CMP   IS,WJV3,1           COMPARE WITH MIN INCREMENT       368
06ED  C104 06AE           BRCL  LT,WJ603            ILLEGAL - TOO SMALL              369
06EF  9C03 09EE           STR   D,WJV3,WJSFIN       SAVE INCREMENT                   370
06C1                      DS    10                  SPACE FOR PATCHES                371
                     .                                                               372
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LOC   OBJECT CODE       CARD IMAGE                                                                       CARDNUM
                        . OUTPUT TITLE AND GET SIGNAL STRENGTH                                              373
                        .                                                                                   374
06CB  E101 0BBE         WJ604    LDR    I,WJV1,WJSSS        GET ADDRESS OF SIGNAL STRENGTH TITLE            375
06CD  ED00 07AE                  BAL    I,RET,WJ90          OUTPUT TILE AND GET ENTRY                       376
06CF  C107 06CB                  BRCL   U,WJ604             ILLEGAL ENTRY                                   377
06D1  B103 0100                  CMP    I,WJV3,0100         COMPARE WITH MAX VALUE                          378
06D3  C101 06CB                  BRCL   GT,WJ604            ILLEGAL - TOO LARGE                             379
06D5  2032                       CMP    IS,WJV2,3           COMPARE COUNT WITH MAX                          380
06D6  C101 06CB                  BRCL   GT,WJ604            ILLEGAL - TOO LARGE                             381
06D8  E032                       LDR    R,WJV2,WJV3         PUT SIGNAL STRENGTH IN REG 2                    382
06D9  ED00 098E                  BAL    I,RET,WJBCDH        CONVERT BCD TO HEX                              383
06DB  CD01 007F                  MUL    I,WJV1,07F          MULTIPLY BY 127                                 384
06DD  6321                       ADD    IS,WJV1,032         ROUND                                           385
06DE  4643                       LDR    IS,WJV3,064         SET UP DIVISOR                                  386
06DF  FC31                       DIV    R,WJV1,WJV3         DIVIDE BY 100                                   387
06E0  A102 007F                  AND    I,WJV2,07F          CLEAR ALL BUT VALUE WANTED                      388
06E2  9C02 09EF                  STR    D,WJV2,WJSFSS       STORE DESIRED SIGNAL STRENGTH                   389
06E4                             DS     10                  SPACE FOR PATCHES                               390
                        .                                                                                   391
                        . OUTPUT FREQUENCY TO RECEIVER AND GET RESPONSE                                     392
                        .                                                                                   393
06EE  E205 09ED         WJ605    LDR    D,WJV5,WJSFLL       GET LOWER LIMIT (LOWER)                         394
06F0  E206 09EC                  LDR    D,WJV6,WJSFLU       GET LOWER LIMIT (UPPER)                         395
06F2  F835              WJ606    SHD    LL,WJV5,4           POSITION FREQUENCY FOR WJ                       396
06F3  E203 09C9                  LDR    D,WJV3,WJCW2        GET CONTROL WORD 2 (FREQ LOWER)                 397
06F5  E204 09C8                  LDR    D,WJV4,WJCW1        GET CONTROL WORD 1 (FREQ UPPER)                 398
06F7  A103 000F                  AND    I,WJV3,0F           CLEAR OLD FREQ (LOWER)                          399
06F9  A104 0000                  AND    I,WJV4,0            CLEAR OLD FREQ (UPPER)                          400
06FB  A453                       IOR    R,WJV3,WJV5         PUT IN NEW FREQ (LOWER)                         401
06FC  A464                       IOR    R,WJV4,WJV6         PUT IN NEW FREQ (UPPER)                         402
06FD  9C03 09C9                  STR    D,WJV3,WJCW2        SAVE NEW CONTROL WORD 2                         403
06FF  9C04 09C8                  STR    D,WJV4,WJCW1        SAVE NEW CONTROL WORD 1                         404
0701  ED00 08AE                  BAL    I,RET,WJS           SEND /RECEIVE NEW CONTROL WORD                  405
0703                             DS     10                  SPACE FOR PATCHES                               406
                        .                                                                                   407
                        . COMPARE RECEIVED SIGNAL STRENGTH WITH SET SIGNAL STRENGTH                         408
                        .                                                                                   409
070D  E201 09CF                  LDR    D,WJV1,WJRS4        GET RECEIVED WORD 4                             410
070F  A101 007F                  AND    I,WJV1,07F          CLEAR ALL BUT SIGNAL STRENGTH                   411
0711  E202 09EF                  LDR    D,WJV2,WJSFSS       GET SPECIFIED SIGNAL STRENGTH                   412
0713  B021                       CMP    R,WJV1,WJV2         COMPARE RECEIVED WITH SPECIFIED                 413
0714  C103 074E                  BRCL   GE,WJ609            FIND                                            414
0716                             DS     10                  SPACE FOR PATCHES                               415
                        .                                                                                   416
                        . INCREMENT FREQUENCY AND TRY AGAIN                                                 417
                        .                                                                                   418
0720  E201 09C9                  LDR    D,WJV1,WJCW2        GET LAST FREQ (LOWER)                           419
0722  E202 09C8                  LDR    D,WJV2,WJCW1        GET LAST FREQ (UPPER)                           420
0724  E831                       SHD    RL,WJV1,4           POSITION FOR INCREMENT                          421
0725  A102 03FF                  AND    I,WJV2,03FF         CLEAR ALL BUT FREQUENCY                         422
0727  E203 09EE                  LDR    D,WJV3,WJSFIN       GET INCREMENT                                   423
0729  4004                       LDR    IS,WJV4,0           CLEAR REGISTER                                  424
072A  ED00 0861                  BAL    I,RET,WJ96          INCREMENT FREQUENCY                             425
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LOC   OBJECT CODE     CARD IMAGE                                                                             CARDNUM
072C  E201 09EB               LDR    D,WJV1,WJSFUL         GET UPPER LIMIT (LOWER)                              426
072E  E202 09EA               LDR    D,WJV2,WJSFUU         GET UPPER LIMIT (UPPER)                              427
0730  B062                    CMP    R,WJV2,WJV6           COMPARE UPPER LIMIT AND FREQ (UPPER)                 428
0731  C101 06F2               BRCL   GT,WJ606              FREQ BELOW LIMIT, KEEP LOOKING                       429
0733  C102 073F               BRCL   EQ,WJ608              UPPER FREQ MATCH,CHECK LOWERS                        430
0735  E201 09F0     WJ607     LDR    D,WJV1,WJSCNT         GET COUNT OF NO. OF TIME THRU                        431
0737  6011                    ADD    IS,WJV1,1             INCREMENT COUNT                                      432
0738  2641                    CMP    IS,WJV1,100           COMPARE WITH MAX TIMES THRU                          433
0739  C101 075E               BRCL   GT,WJ610              DONE - NO FIND                                       434
073B  9C01 09F0               STR    D,WJV1,WJSCNT         SAVE NEW COUNT                                       435
073D  C107 06EE               BRCL   U,WJ605               GO START AT LOWER LIMIT AGAIN                        436
073F  B051          WJ608     CMP    R,WJV1,WJV5           COMPARE LOWERS OF UPPER LIMIT AND FR                 437
0740  C104 0735               BRCL   LT,WJ607              LESS, GO START AGAIN                                 438
0742  C107 06F2               BRCL   U,WJ606               GO DO WITH NEW FREQUENCY                             439
0744                          DS     10                    SPACE FOR PATCHES                                    440
                    .                                                                                           441
                    . FIND                                                                                      442
                    .                                                                                           443
C74E  BC11 09E0     WJ609     LDRM   D,WJV1,WJRFL,2        GET RECEIVED FREQUENCY (DISPLAY)                     444
0750  9C11 09D8               STRM   D,WJV1,WJCFL,2        STORE IN CONTROL FREQ (DISPLAY)                      445
0752  C107 05DE               BRCL   U,WJ40                GO DISPLAY RECEIVED WORD                             446
0754                          DS     10                    SPACE FOR PATCHES                                    447
                    .                                                                                           448
                    . NO FINI - TELL OPERATOR                                                                   449
                    .                                                                                           450
075E  BC11 09E0     WJ610     LDRM   D,WJV1,WJRFL,2        GET LAST RECEIVED FREQ (DISPLAY)                     451
0760  9C11 09D8               STRM   D,WJV1,WJCFL,2        STORE IN CONTROL FREQ (DISPLAY)                      452
0762  E101 0ECA               LDR    I,WJV1,WJSNF          GET ADDRESS OF NO FIND MESSAGE                       453
0764  ED00 0230               BAL    I,RET,OUTPUT          OUTPUT MESSAGE                                       454
0766  C107 0519               BRCL   U,WJ02                DONE                                                 455
0768                          DS     40                    SPACE FOR PATCHES                                    456
                    .                                                                                           457
                    .                                                                                           458
                    .                                                                                           459
                    .                                                                                           460
                    . ************************************************                                          461
                    . RECEIVE CONTROL WORD FROM RECEIVER (COMMAND=6)                                            462
                    . ************************************************                                          463
                    .                                                                                           464
0790  E101 0001     WJ70      LDR    I,WJV1,01             LOAD FLAG TO INHIBIT COMPARE                         465
0792  9C01 09F4               STR    D,WJV1,CHKFLG1        STORE FLAG                                           466
0794  ED00 08E1               BAL    I,RET,WJR             INPUT RECEIVER CONTROL WORDS                         467
0796  E101 0000               LDR    I,WJV1,0              ZERO REGISTER                                        468
0798  9C01 09F4               STR    D,WJV1,CHKFLG1        CLEAR FLAG                                           469
079A  C107 05DE               BRCL   U,WJ40                DISPLAY RECEIVED WORDS                               470
079C  C107 0519               BRCL   U,WJ02                RETURN                                               471
079E                          DS     10                    SPACE FOR PATCHES                                    472
                    .                                                                                           473
                    .                                                                                           474
                    .                                                                                           475
                    .                                                                                           476
                    . ***************                                                                           477
                    . DONE (COMMAND=7)                                                                          478
```

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LOC   CBJECT CODE     CARD IMAGE
                    . ***************
                    .
07A8  B601 09B4     WJ80      LLC    D,WJV1,WJCRF           LOAD "ADDRESS OFF"
07AA  D912                    ROUT   02,WJV1                TURN OFF INTERFACE
07AB  E200 09AD               LDR    D,RET,WJRET            LOAD RETURN ADDRESS
07AD  BF07                    BRC    R,7,RET                RETURN TO CALLER
                    .
                    .
                    .
                    .*********************************************************************
                    . ROUTINE TO OUTPUT BUFFER AND GET ENTRY FROM KEYBCARD
                    . ENTRY: WJV1 ADDRESS OF BUFFER TO BE OUTPUT
                    . EXIT:  WJV2 NUMBER OF CHARACTERS ENTERED
                    .        WJV3 ENTRY (LOWER) BCD
                    .        WJV4 ENTRY (UPPER) BCD
                    . RETUBN FOR ILLEGAL ENTRY
                    . RETURN+2 FOR LEGAL ENTRY
                    .*********************************************************************
                    .
07AE  9C00 09F1     WJ90      STR    D,RET,WJ90R            SAVE THE RETURN ADDRESS
07B0  ED00 0230               BAL    I,RET,OUTPUT           OUTPUT BUFFER
07B2  ED00 0151               BAL    I,RET,KEYMR            GET INPUT FROM KEYBOARD
07B4  4003                    LDR    IS,WJV3,0              CLEAR REGISTER
07B5  4004                    LDR    IS,WJV4,0              CLEAR REGISTER
07B6  4005                    LDR    IS,WJV5,0              CLEAR REGISTER
07B7  5152                    LDR    RX,WJV2,WJV5,WJV1      GET COUNT FROM KEYMR
07B8  E027                    LDR    R,WJV7,WJV2            SET UP INDEX FOR LOOP
07B9  E200 09F1               LDR    D,RET,WJ90R            GET RETURN ADDRESS
07BB  6FF7                    ADD    IS,WJV7,-1             DECREMENT COUNT
07BC  BF04                    BRC    R,4,RET                ILLEGAL IF NEG, NOTHING ENTERED
07BD  6011          WJ901     ADD    IS,WJV1,1              INCREMENT BUFFER POINTER
07BE  5156                    LDR    RX,WJV6,WJV5,WJV1      GET ONE CHARACTER
07BF  2306                    CMP    IS,WJV6,030            COMPARE CHAR WITH ASCII ZERO
07C0  BF04                    BRC    R,4,RET                ILLEGAL CHARACTER IS LESS
07C1  2396                    CMP    IS,WJV6,039            COMPARE WITH ASCII 9
07C2  BF01                    BRC    R,1,RET                ILLEGAL CHARACTER IS GREATER
07C3  A106 000F               AND    I,WJV6,0F              CLEAR UPPER 12 EITS
07C5  F833                    SHD    LL,WJV3,4              POSITION ENTRY FOR NEW CHARACTER
07C6  A463                    IOR    R,WJV3,WJV6            OR IN NEW CHARACTER
07C7  6FF7                    ADD    IS,WJV7,-1             DECREMENT COUNT
07C8  C103 07BD               BRCL   NN,WJ901               KEEP GOING IF MORE CHARACTERS
07CA  6020                    ADD    IS,RET,2               INCREMENT RETURN ADDRESS
07CB  BF07                    BRC    R,7,RET                LEGAL RETURN
                    .
                    .
                    .
                    .*********************************************************************
                    . ROUTINE TO CHECK A FREQUENCY ENTRY AND MAKE SURE IT IS IN WJ
                    . FREQUENCY LIMITS
                    . ENTRY: WJV2  NUMBER OF CHARACTERS ENTERED
                    .        WJV3 FREQUENCY (LOWER) BCD,1 HZ RESOLUTION
```

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LOC   OBJECT CODE     CARD IMAGE                                                                    CARDNUM
                   .          WJV4 FREQUENCY (UPPER) BCD,1HZ RESOLUTION
                   . EXIT:    WJV3 FREQUENCY (LOWER) BCD,10 HZ RESOLUTION
                   .          WJV4 FREQUENCY (UPPER) BCD,10 HZ RESOLUTICN
                   . RETURN FOR ILLEGAL ENTRY
                   . RETURN+2 FOR LEGAL ENTRY
                   .*******************************************************************
                   .
07CC  2082         WJ91       CMP   IS,WJV2,8        COMPARE WITH MAX COUNT
07CD  BF01                    BRC   R,1,RET          ILLEGAL - TOO MANY
07CE  2062                    CMP   IS,WJV2,6        COMPARE COUNT WITH MIN
07CF  BF04                    BRC   R,4,RET          ILLEGAL - TOO FEW
07D0  E833                    SHD   RL,WJV3,4        POSITION FREQUENCY FOR WJ
07D1  B104 0305               CMP   I,WJV4,0305      COMPARE WITH MAX FREQUENCY
07D3  BF01                    BRC   R,1,RET          ILLEGAL - TOO LARGE
07D4  B104 0005               CMP   I,WJV4,05        COMPARE WITH MIN FREQUENCY
07D6  BF04                    BRC   R,4,RET          ILLEGAL - TOO SMALL
07D7  6020                    ADD   IS,RET,2         INCREMENT RETURN ADDRESS
07D8  BF07                    BRC   R,7,RET          LEGAL RETURN
                   .
                   .
                   .
                   .
                   .*******************************************************************
                   . ROUTINE TO DISPLAY FREQUENCY
                   . WJV1 FREQUENCY (LOWER) IN DISPLAY FORMAT
                   . WJV2 FREQUENCY (UPPER) IN DISPLAY FORMAT
                   .*******************************************************************
                   .
07D9  9C00 09E1    WJ92       STR   D,RET,WJ90R      SAVE RETURN ADDRESS
07DB  E104 3030               LDR   I,WJV4,03030     SET UP ASCII CONVERSION CONSTANT
07DD  4003                    LDR   IS,WJV3,0        CLEAR REGISTER
07DE  F831                    SHD   LL,WJV1,4        SET FREQUENCY TO 1 HZ RESOLUTION
07DF  F832                    SHD   LL,WJV2,4        POSITION 1ST 2 DIGITS
07E0  AE33                    SHS   LL,WJV3,4
07E1  F832                    SHD   LL,WJV2,4
07E2  A443                    IOR   R,WJV3,WJV4      CONVERT TO ASCII
07E3  9C03 0ADD               STR   D,WJV3,WJDP1     PUT 1ST 2 DIGITS IN DISPLAY BUFFER
07E5  4003                    LDR   IS,WJV3,0        CLEAR REGISTER
07E6  F832                    SHD   LL,WJV2,4        POSITION 2ND 2 DIGITS
07E7  AE33                    SHS   LL,WJV3,4
07E8  F832                    SHD   LL,WJV2,4
07E9  A443                    IOR   R,WJV3,WJV4      CONVERT TO ASCII
07EA  9C03 0ADE               STR   D,WJV3,WJDP1+1   PUT IN DISPLAY BUFFER
07EC  4002                    LDR   IS,WJV2,0        CLEAR REGISTER
07ED  F831                    SHD   LL,WJV1,4        POSITION 3RD 2 DIGITS
07EE  AE32                    SHS   LL,WJV2,4
07EF  F831                    SHD   LL,WJV1,4
07F0  A442                    IOR   R,WJV2,WJV4      CONVERT TO ASCII
07F1  9C02 0ADF               STR   D,WJV2,WJDP1+2   PUT IN DISPLAY BUFFER
07F3  4002                    LDR   IS,WJV2,0        CLEAR REGISTER
07F4  F831                    SHD   LL,WJV1,4        POSITION LAST 2 DIGITS
07F5  AE32                    SHS   LL,WJV2,4
07F6  F831                    SHD   LL,WJV1,4
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LOC   OBJECT CODE      CARD IMAGE                                                                      CARDNUM
07F7  A442                       IOR   R,WJV2,WJV4          CONVERT TO ASCII                              585
07F8  9C02 0AE0                  STR   D,WJV2,WJDF1+3       PUT IN DISPLAY BUFFER                         586
07FA  E101 0AC8                  LDR   I,WJV1,WJDF          GET ADDRESS OF OUTPUT BUFFER                  587
07FC  ED00 0230                  BAL   I,RET,OUTPUT         OUTPUT BUFFER                                 588
07FE  E200 09F1                  LDR   D,RET,WJ90R          GET RETURN ADDRESS                            589
0800  BF07                       BRC   R,7,RET              RETURN TO CALLER                              590
                    .                                                                                     591
                    .                                                                                     592
                    .                                                                                     593
                    .                                                                                     594
                    .************************************************************************            595
                    . ROUTINE TO DISPLAY GAIN MODE AND IF BANDWIDTH                                       596
                    . WJV1 GAIN MODE IN DISPLAY FORMAT                                                    597
                    . WJV2 IF BANDWIDTH IN DISPLAY FORMAT                                                 598
                    .************************************************************************            599
                    .                                                                                     600
0801  9C00 09F1     WJ93         STR   D,RET,WJ90R          SAVE RETURN ADDRESS                           601
0803  9C02 09F2                  STR   D,WJV2,WJ90S1        SAVE IF BANDWIDTH                             602
0805  9C01 09F3                  STR   D,WJV1,WJ90S2        SAVE GAIN MODE                                603
0807  E101 0AFB                  LDR   I,WJV1,WJDGM         GET ADDRESS OF BUFFER TO OUTPUT               604
0809  ED00 0230                  BAL   I,RET,OUTPUT         OUTPUT BUFFER                                 605
080B  E202 09F3                  LDR   D,WJV2,WJ90S2        PUT GAIN MODE IN REG 2                        606
080D  E103 0B27                  LDR   I,WJV3,WJGMTB        GET ADDRESS OF GAIN MODE TABLE                607
080F  5321                       LDR   RX,WJV1,WJV2,WJV3    GET ADDRESS OF BUFFER TO OUTPUT               608
0810  ED00 0230                  BAL   I,RET,OUTPUT         OUTPUT BUFFER                                 609
0812  E101 0B03                  LDR   I,WJV1,WJDIF         GET ADDRESS OF BUFFER TO OUTPUT               610
0814  ED00 0230                  BAL   I,RET,OUTPUT         OUTPUT BUFFER                                 611
0816  E202 09F2                  LDR   D,WJV2,WJ90S1        GET IF BANDWIDTH                              612
0818  E103 0B42                  LDR   I,WJV3,WJIFTB        GET ADDRESS OF IF BANDWIDTH TABLE             613
081A  5321                       LDR   RX,WJV1,WJV2,WJV3    GET ADDRESS OF BUFFER TO OUTPUT               614
081B  ED00 0230                  BAL   I,RET,OUTPUT         OUTPUT IF BANDWIDTH BUFFER                    615
081D  E200 09F1                  LDR   D,RET,WJ90R          GET RETURN ADDRESS                            616
081F  BF07                       BRC   R,7,RET              RETURN TO CALLER                              617
                    .                                                                                     618
                    .                                                                                     619
                    .                                                                                     620
                    .                                                                                     621
                    .************************************************************************            622
                    . ROUTINE TO DISPLAY DETECT MODE AND BFO FREQUENCY                                    623
                    . WJV1 DETECT MODE IN DISPLAY FORMAT                                                  624
                    . WJV2 BFO FREQUENCY (LOWER) IN DISPLAY FORMAT                                        625
                    .************************************************************************            626
                    .                                                                                     627
0820  9C00 09F1     WJ94         STR   D,RET,WJ90R          SAVE RETURN ADDRESS                           628
0822  9C01 09F2                  STR   D,WJV1,WJ90S1        SAVE DETECT MODE                              629
0824  9C02 09F3                  STR   D,WJV2,WJ90S2        SAVE BFO FREQUENCY                            630
0826  E101 0AE5                  LDR   I,WJV1,WJDDM         GET ADDRESS OF BUFFER TO OUTPUT               631
0828  ED00 0230                  BAL   I,RET,OUTPUT         OUTPUT BUFFER                                 632
082A  E202 09F2                  LDR   D,WJV2,WJ90S1        GET DETECT MODE                               633
082C  E103 0B61                  LDR   I,WJV3,WJDMTB        GET ADDRESS OF DETECT MODE TABLE              634
082E  5321                       LDR   RX,WJV1,WJV2,WJV3    GET ADDRESS OF BUFFER TO OUTPUT               635
082F  ED00 0230                  BAL   I,RET,OUTPUT         OUTPUT BUFFER                                 636
0831  E201 09F3                  LDR   D,WJV1,WJ90S2        GET BFO FREQUENCY                             637
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LOC   OBJECT CODE      CARD IMAGE

0833  4002                    LDR   IS,WJV2,0              CLEAR REGISTER
0834  F831                    SHD   LL,WJV1,4              POSITION UPPER 2 DIGITS
0835  AE32                    SHS   LL,WJV2,4
0836  F831                    SHD   LL,WJV1,4
0837  A502 3030               IOR   I,WJV2,03030           CONVERT TO ASCII
0839  9C02 0AF5               STR   D,WJV2,WJDBF1          STORE IN OUTPUT BUFFER
083B  4002                    LDR   IS,WJV2,0              CLEAR REGISTER
083C  F831                    SHD   LL,WJV1,4              POSITION LOWER 2 DIGITS
083D  AE32                    SHS   LL,WJV2,4
083E  F831                    SHD   LL,WJV1,4
083F  A502 3030               IOR   I,WJV2,03030           CONVERT TO ASCII
0841  9C02 0AF6               STR   D,WJV2,WJDBF1+1        STORE IN OUTPUT BUFFER
0843  E101 0AEE               LDR   I,WJV1,WJDBF           GET ADDRESS OF BUFFER TO OUTPUT
0845  ED00 0230               BAL   I,RET,OUTPUT           OUTPUT BUFFER
0847  E200 09F1               LDR   D,RET,WJ90R            GET RETURN ADDRESS
0849  BF07                    BRC   R,7,RET                RETURN TO CALLER
                 .
                 .
                 .
                 .***********************************************************************
                 . ROUTINE TO DISPLAY RF GAIN
                 . WJV1 RF GAIN IN DISPLAY FORMAT
                 .***********************************************************************
                 .
C84A  9C00 09F1  WJ95         STR   D,RET,WJ90R            SAVE RETURN ADDRESS
084C  4002                    LDR   IS,WJV2,0              CLEAR REGISTER
084D  F871                    SHD   LL,WJV1,8              POSITION FIRST DIGIT
084E  A502 2030               IOR   I,WJV2,02030           CONVERT TO ASCII
0850  9C02 0B13               STR   D,WJV2,WJDRF1          STORE IN DISPLAY BUFFER
0852  4002                    LDR   IS,WJV2,0              CLEAR REGISTER
0853  F831                    SHD   LL,WJV1,4              POSITION LAST 2 DIGITS
0854  AE32                    SHS   LL,WJV2,4
0855  F831                    SHD   LL,WJV1,4
0856  A502 3030               IOR   I,WJV2,03030           CONVERT TO ASCII
0858  9C02 0B14               STR   D,WJV2,WJDRF1+1        STORE IN DISPLAY BUFFER
085A  E101 0B0D               LDR   I,WJV1,WJDRF           GET ADDRESS OF BUFFER TO OUTPUT
085C  ED00 0230               BAL   I,RET,OUTPUT           OUTPUT BUFFER
085E  E200 09F1               LDR   D,RET,WJ90R            GET RETURN ADDRESS
0860  BF07                    BRC   R,7,RET                RETURN TO CALLER
                 .
                 .
                 .
                 .***********************************************************************
                 . ROUTINE TO INCREMENT FREQUENCY
                 . WJV1 FREQUENCY IN DISPLAY FORMAT (LOWER)
                 . WJV2 FREQUENCY IN DISPLAY FORMAT (UPPER)
                 . WJV3 FREQUENCY INCREMENT IN DISPLAY FORMAT (LOWER)
                 . WJV4 FREQUENCY INCREMENT IN DISPLAY FORMAT (UPPER)
                 . WJV5 ANSWER FREQUENCY IN DISPLAY FORMAT (LOWER)
                 . WJV6 ANSWER FREQUENCY IN DISPLAY FORMAT (UPPER)
                 .***********************************************************************
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ATAC                                                                  TIME: 16:43:42     03/18/77     PAGE    14
IOC   OBJECT CODE      CARD IMAGE                                                                   CARDNUM
                                                                                                       691
C861  9C00 09F1   WJ96        STR   D,RET,WJ90R         SAVE RETURN ADDRESS                            692
0863  E109 000F               LDR   I,WJV9,0000F        SET UP MASK                                    693
0865  4005                    LDR   IS,WJV5,0           CLEAR REGISTER                                 694
0866  4006                    LDR   IS,WJV6,0           CLEAR REGISTER                                 695
0867  E017                    LDR   R,WJV7,WJV1         DO 1ST DIGIT                                   696
0868  E038                    LDR   R,WJV8,WJV3                                                        697
0869  ED00 08A4               BAL   I,RET,WJ961                                                        698
086B  E075                    LDR   R,WJV5,WJV7                                                        699
086C  E017                    LDR   R,WJV7,WJV1         DO 2ND DIGIT                                   700
086D  AD37                    SHS   RL,WJV7,4                                                          701
086E  8087                    ADD   R,WJV7,WJV8                                                        702
086F  E038                    LDR   R,WJV8,WJV3                                                        703
0870  AD38                    SHS   RL,WJV8,4                                                          704
0871  ED00 08A4               BAL   I,RET,WJ961                                                        705
0873  AE37                    SHS   LL,WJV7,4                                                          706
0874  A475                    IOR   R,WJV5,WJV7                                                        707
0875  E017                    LDB   R,WJV7,WJV1         DO 3RD DIGIT                                   708
0876  AD77                    SHS   RL,WJV7,8                                                          709
0877  8087                    ADD   R,WJV7,WJV8                                                        710
0878  E038                    LDR   R,WJV8,WJV3                                                        711
0879  AD78                    SHS   RL,WJV8,8                                                          712
087A  ED00 08A4               BAL   I,RET,WJ961                                                        713
087C  AE77                    SHS   LL,WJV7,8                                                          714
087D  A475                    IOR   R,WJV5,WJV7                                                        715
087E  E017                    LDR   R,WJV7,WJV1         DO 4TH DIGIT                                   716
087F  ADB7                    SHS   RL,WJV7,12                                                         717
0880  8087                    ADD   R,WJV7,WJV8                                                        718
0881  E038                    LDR   R,WJV8,WJV3                                                        719
0882  ADB8                    SHS   RL,WJV8,12                                                         720
0883  ED00 08A4               BAL   I,RET,WJ961                                                        721
0885  AEB7                    SHS   LL,WJV7,12                                                         722
0886  A475                    IOR   R,WJV5,WJV7                                                        723
0887  E027                    LDR   R,WJV7,WJV2         DO 5TH DIGIT                                   724
0888  8087                    ADD   R,WJV7,WJV8                                                        725
0889  E048                    LDR   R,WJV8,WJV4                                                        726
088A  ED00 08A4               BAL   I,RET,WJ961                                                        727
088C  E076                    LDR   R,WJV6,WJV7                                                        728
088D  E027                    LDR   R,WJV7,WJV2         DO 6TH DIGIT                                   729
088E  AD37                    SHS   RL,WJV7,4                                                          730
088F  8087                    ADD   R,WJV7,WJV8                                                        731
0890  E048                    LDR   R,WJV8,WJV4                                                        732
0891  AD38                    SHS   RL,WJV8,4                                                          733
0892  ED00 08A4               BAL   I,RET,WJ961                                                        734
0894  AE37                    SHS   LL,WJV7,4                                                          735
0895  A476                    IOR   R,WJV6,WJV7                                                        736
0896  E027                    LDR   R,WJV7,WJV2         DO 7TH DIGIT                                   737
0897  AD77                    SHS   RL,WJV7,8                                                          738
0898  8087                    ADD   R,WJV7,WJV8                                                        739
0899  E048                    LDR   R,WJV8,WJV4                                                        740
089A  AD78                    SHS   RL,WJV8,8                                                          741
089B  ED00 08A4               BAL   I,RET,WJ961                                                        742
089D  AE77                    SHS   LL,WJV7,8                                                          743
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
089E  A476            IOR   R,WJV6,WJV7                                             744
089F  AEB8            SHS   LL,WJV8,12          DO LAST DIGIT                       745
08A0  A486            IOR   R,WJV6,WJV8                                           746
08A1  E200 09F1       LDR   D,RET,WJ90R         GET RETURN ADDRESS                  747
08A3  BF07            BRC   R,7,RET             RETURN                              748
                                                                                    749
08A4  A097      WJ961 AND   R,WJV7,WJV9         CLEAR ALL BUT DIGIT                 750
08A5  A098            AND   R,WJV8,WJV9         CLEAR ALL BUT DIGIT                 751
08A6  8087            ADD   R,WJV7,WJV8         ADD DIGITS TOGETHER                 752
08A7  4008            LDR   IS,WJV8,0           CLEAR REGISTER                      753
08A8  20A7            CMP   IS,WJV7,10          COMPARE WITH DECIMAL 10             754
08A9  C104 08AD       BRCL  LT,WJ962            LESS - NO CARRY                     755
08AB  6F67            ADD   IS,WJV7,-10         DECREMENT ANSWER BY 10              756
08AC  4018            LDR   IS,WJV8,1           CARRY ONE                           757
08AD  BF07      WJ962 BRC   R,7,RET             RETURN TO CALLER                    758
                      .                                                             759
                      .                                                             760
                      .                                                             761
                      .                                                             762
                      .*************************************************************** 763
                      . SEND START CODE TO RECEIVER                                 764
                      . SEND CONTROL WORD TO RECEIVER                               765
                      . SEND END CODE TO RECEIVER                                   766
                      .*************************************************************** 767
                      .                                                             768
08AE  B60B 09AE WJS   LLC   D,WJXX,WJCRS        XAR  FOR RCVR CHECK                 769
08E0  B603 09B0       LLC   D,WJX1,WJCRD1       XAR FOR CONTROL WORD ONE            770
08E2  B604 09B1       LLC   D,WJX2,WJCRD2       XAR FOR CONTROL WORD TWO            771
08E4  B605 09B2       LLC   D,WJX3,WJCRD3       "   "       "   THREE               772
08E6  B606 09B3       LLC   D,WJX4,WJCRD4       "   "       "   FOUR                773
08B8  B602 09AF       LLC   D,WJXE,WJCRE        XAR FOR END OF LOAD                 774
08BA  E207 09C8       LDR   D,WJD1,WJCW1        CONTROL WORD ONE                    775
08BC  E208 09C9       LDR   D,WJD2,WJCW2        TWO                                 776
08BE  E209 09CA       LDR   D,WJD3,WJCW3        THREE                               777
08C0  E20A 09CB       LDR   D,WJD4,WJCW4        FOUR                                778
08C2  D937            ROUT  WJD1,WJX1           SEND DATA WORD 1                    779
08C3  D948            ROUT  WJD2,WJX2           SEND DATA WORD 2                    780
08C4  D959            ROUT  WJD3,WJX3           SEND DATA WORD 3                    781
08C5  D96A            ROUT  WJD4,WJX4           SEND DATA WORD 4                    782
08C6  8CB1      WJS1  RIN   WJV1,WJXX           INPUT RCVR CHECK WORD               783
08C7  E20F 09F5       LDR   D,WJLPC,WJLPL       LOAD COUNTER                        784
08C9  601F            ADD   IS,WJLPC,01         INCREMENT COUNTER                   785
08CA  B10F 0014       CMP   I,WJLPC,20          COMPARE WITH 32 TIMES               786
08CC  C103 09A4       ERCL  GE,WJCKF            BRANCH IF GREATER OR EQUAL          787
08CE  9C0F 09F5       STR   D,WJLPC,WJLPL       SAVE COUNT                          788
08D0  9E01 0001       CMPL  I,WJV1,01           CHECK TO SEE IF READY               789
08D2  C105 08C6       BRCL  NE,WJS1             LOOP IF NOT READY                   790
08E4  D921            ROUT  WJV1,WJXE           SEND TRIGGER                        791
08D5  400F            LDR   IS,WJLPC,0          ZERO COUNTER                        792
08D6  9C0F 09F5       STR   D,WJLPC,WJLPL       STORE COUNT                         793
08D8  E20F 09F6       LDR   D,WJLPC,WJLPK       LOAD WJS COUNTER                    794
08DA  601F            ADD   IS,WJLPC,01         INCREMENT COUNTER                   795
08DB  B10F 0005       CMP   I,WJLPC,05          FIVE TIMES THROUGH?                 796
```

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LOC   OBJECT CODE     CARD IMAGE                                                                CARDNUM
08DD  C103 09A4           BRCL  GE,WJCKF          YES-EXIT / NO-CONTINUE                          797
08DF  9C0F 09F6           STR   D,WJLPC,WJLPK     SAVE COUNT                                      798
                      .                                                                           799
                      .                                                                           800
                      .                                                                           801
                      .                                                                           802
                      .*************************************************************************  803
                      . SEND 'START TO SEND' CODE TO RECEIVER                                     804
                      . GET CONTROL WORD FROM RECEIVER                                            805
                      . SEND 'END OF SEND' TO RECEIVER                                            806
                      . CONVERT RECEIVED WORD TO DISPLAY FORMAT                                   807
                      .*************************************************************************  808
                      .                                                                           809
08E1  9C00 09F1  WJR      STR   D,RET,WJ90R       SAVE RETURN ADDRESS                             810
08E3  E60B 09AE           LLC   D,WJXX,WJCRS      XAR FOR RECEIVER CHECK                          811
08E5  B601 09B9           LLC   D,WJXS,WJRCB      XAR  TO START LOAD/STOP MON CLK                 812
08E7  B603 09B5           LLC   D,WJX1,WJRCD1     XAR FOR CONTROL WORD ONE                        813
08E9  B604 09B6           LLC   D,WJX2,WJRCD2     TWO                                             814
08EB  B605 09B7           LLC   D,WJX3,WJRCD3     THREE                                           815
08ED  B606 09B8           LLC   D,WJX4,WJRCD4     FOUR                                            816
08EF  B602 09BA           LLC   D,WJXE,WJRCE      XAR TO END INPUT/START MON CLK                  817
08F1  8CB7       WJR1     RIN   WJD1,WJXX         INPUT CHECK                                     818
08F2  E20F 09F5           LDR   D,WJLPC,WJLPL     LOAD COUNTER                                    819
08F4  601F                ADD   IS,WJLPC,01       INCREMENT COUNTER                               820
08F5  B10F 0014           CMP   I,WJLPC,20        COMPARE WITH 32 TIMES                           821
08F7  C103 09A4           BRCL  GE,WJCKF          BRANCH IF GREATER OR EQUAL                      822
08F9  9C0F 09F5           STR   D,WJLPC,WJLPL     SAVE COUNT                                      823
08FB  9E07 0001           CMPL  I,WJD1,01         CHECK TO SEE IF READY                           824
08FD  C105 08F1           BRCL  NE,WJR1           LOOP IF NOT READY                               825
08FF  D917                ROUT  WJD1,WJXS         STOP MONITOR CLOCK                              826
0900  8C37                RIN   WJD1,WJX1         INPUT FIRST CONTROL WORD                        827
0901  8C48                RIN   WJD2,WJX2         SECOND                                          828
0902  8C59                RIN   WJD3,WJX3         THIRD                                           829
0903  8C6A                RIN   WJD4,WJX4         FOURTH                                          830
0904  D927                ROUT   WJD1,WJXE        START MONITOR CLOCK                             831
0905  9C37 09CC           STRM  D,WJD1,WJRS1,4    STORE RECEIVED DATA WORDS                       832
0907  E201 09F4           LDR   D,WJV1,CHKPLG1    LOAD REG 1 FOR CHECK                            833
0909  9E01 0001           CMPL  I,WJV1,01         CHECK FOR COMMAND 6                             834
090B  C102 0921           BRCL  EQ,WJR2           COMMAND 6=BRANCH                                835
090D  E204 09C8           LDR   D,WJV4,WJCW1      CONTROL WORD ONE                                836
090F  E205 09C9           LDR   D,WJV5,WJCW2      TWO                                             837
0911  E206 09CA           LDR   D,WJV6,WJCW3      THREE                                           838
0913  B047                CMP   R,WJD1,WJV4       COMPARE SENT AND RECEIVED WORDS 1               839
0914  C105 08AE           BRCL  NE,WJS            NOT THE SAME-SEND AGAIN                         840
0916  B058                CMP   R,WJD2,WJV5       COMPARE 2                                       841
0917  C105 08AE           BRCL  NE,WJS            NOT THE SAME-SEND AGAIN                         842
0919  B069                CMP   R,WJD3,WJV6       COMPARE 3                                       843
091A  C105 08AE           BRCL  NE,WJS            NOT THE SAME-SEND AGAIN                         844
091C  400F                LDR   IS,WJLPC,0        ZERO COUNTER                                    845
091D  9C0F 09F5           STR   D,WJLPC,WJLPL     STORE COUNT                                     846
091F  9C0F 09F6           STR   D,WJLPC,WJLPK     SAVE COUNT                                      847
0921  E202 09CC  WJR2     LDR   D,WJV2,WJRS1      GET FREQUENCY UPPER                             848
0923  E201 09CD           LDR   D,WJV1,WJRS2      GET FREQUENCY LOWER                             849
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LOC   OBJECT CODE      CARD IMAGE                                                                  CARDNUM
0925  B831                 SHD   RL,WJV1,4              POSITION FREQUENCY FOR DISPLAY              850
0926  A102 03FF            AND   I,WJV2,03FF            CLEAR ALL BUT FREQUENCY                     851
0928  9C01 09E0            STR   D,WJV1,WJRFL           STORE IN RECEIVED DISPLAY (LOWER)           852
092A  9C02 09E1            STR   D,WJV2,WJRFU           STORE IN RECEIVED DISPLAY (UPPER)           853
092C  E201 09CD            LDR   D,WJV1,WJRS2           GET RECEIVED WORD 2                         854
092E  A101 000C            AND   I,WJV1,0C              CLEAR ALL BUT GAIN MODE                     855
0930  AD11                 SHS   RL,WJV1,2              POSITION GAIN MODE                          856
0931  9C01 09E5            STR   D,WJV1,WJRGM           STORE IN RECEIVED GAIN MODE FOR DISP        857
0933  E201 09CE            LDR   D,WJV1,WJRS3           GET RECEIVED WORD 3                         858
0935  E202 09CD            LDR   D,WJV2,WJRS2           GET RECEIVED WORD 2                         859
0937  F801                 SHD   LL,WJV1,1              POSITION RECEIVED BANDWIDTH                 860
0938  A102 0007            AND   I,WJV2,07              CLEAR ALL BUT BANDWIDTH                     861
093A  9C02 09E7            STR   D,WJV2,WJRIF           STORE IN RECEIVED DISPLAY                   862
093C  A101 E000            AND   I,WJV1,0E000           CLEAR ALL BUT DETECT MODE                   863
093E  ADC1                 SHS   RL,WJV1,13             POSITION DETECT MODE                        864
093F  9C01 09E2            STR   D,WJV1,WJRDM           STORE IN RECEIVED DISPLAY                   865
0941  E101 0004            LDR   I,WJV1,04              GET BFO UPPER DISPLAY                       866
0943  9C01 09E4            STR   D,WJV1,WJRBU           STORE IN RECEIVED DISPLAY                   867
0945  E201 09CE            LDR   D,WJV1,WJRS3           GET RECEIVED BFO FREQUENCY                  868
0947  A101 07FF            AND   I,WJV1,07FF            CLEAR ALL BUT BFO FREQUENCY                 869
0949  4002                 LDR   IS,WJV2,0              CLEAR REG 2                                 870
094A  CD01 07D0            MUL   I,WJV1,07D0            MULTIPLY BY 2000                            871
094C  E103 07FF            LDR   I,WJV3,07FF            LOAD DIVISOR                                872
094E  8101 0400            ADD   I,WJV1,0400            ROUND                                       873
0950  FC31                 DIV   R,WJV1,WJV3            DIVIDE                                      874
0951  8102 1194            ADD   I,WJV2,01194           ADD 4500                                    875
0953  4003                 LDR   IS,WJV3,0              CLEAR REG 3                                 876
0954  40A4                 LDR   IS,WJV4,10             SET UP DIVISOR                              877
0955  FC42                 DIV   R,WJV2,WJV4            DIVIDE BY 10                                878
0956  E021                 LDR   R,WJV1,WJV2            PUT REMAINDER IN WJV1 AS 1ST DIGIT          879
0957  E032                 LDR   R,WJV2,WJV3            GET QUOTIENT                                880
0958  4003                 LDR   IS,WJV3,0              CLEAR REGISTER                              881
0959  FC42                 DIV   R,WJV2,WJV4            DIVIDE BY 10                                882
095A  AE32                 SHS   LL,WJV2,4              POSITION 2ND DIGIT                          883
095B  A421                 IOR   R,WJV1,WJV2            PUT 2ND DIGIT IN ANSWER                     884
095C  E032                 LDR   R,WJV2,WJV3            GET QUOTIENT                                885
095D  4003                 LDR   IS,WJV3,0              CLEAR REGISTER                              886
095E  FC42                 DIV   R,WJV2,WJV4            DIVIDE BY 10                                887
095F  AE72                 SHS   LL,WJV2,8              POSITION 3RD DIGIT                          888
0960  AEB3                 SHS   LL,WJV3,12             POSITION 4TH DIGIT                          889
0961  A421                 IOR   R,WJV1,WJV2            PUT IN 3RD DIGIT                            890
0962  A431                 IOR   R,WJV1,WJV3            PUT IN 4TH DIGIT                            891
0963  9C01 09E3            STR   D,WJV1,WJRBL           STORE IN RECEIVED BFO FREQ DISPLAY (        892
0965  E202 09CF            LDR   D,WJV2,WJRS4           GET RECEIVED WORD 4                         893
0967  A102 7F00            AND   I,WJV2,07F00           CLEAR ALL BUT RF GAIN                       894
0969  AD72                 SHS   RL,WJV2,8              RIGHT JUSTIFY                               895
096A  B421                 LLC   R,WJV1,WJV2            COMPLEMENT                                  896
096B  A101 007F            AND   I,WJV1,07F             CLEAR ALL BUT RF GAIN                       897
096D  ED00 097C            BAL   I,RET,WJR3             CONVERT TO BCD PERCENTAGE                   898
096F  9C01 09E6            STR   D,WJV1,WJRRFG          STORE IN RECEIVED DISPLAY                   899
0971  E201 09CF            LDR   D,WJV1,WJRS4           GET RECEIVED WORD 4                         900
0973  A101 007F            AND   I,WJV1,07F             CLEAR ALL BUT SIGNAL STRENGTH               901
0975  ED00 097C            BAL   I,RET,WJR3             CONVERT TO BCD PERCENTAGE                   902
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LOC   OBJECT CODE      CARD IMAGE

0977  9C01 09E9               STR    D,WJV1,WJRSS       STORE IN RECEIVED DISPLAY
0979  E200 09F1               LDR    D,RET,WJ90R        GET RETURN ADDRESS
097B  BF07                    BRC    R,7,RET            RETURN TO CALLER

097C  CD01 0064      WJR3     MUL    I,WJV1,064         MULTIPLY BY 100
097E  6371                    ADD    IS,WJV1,037        ROUND
097F  47F3                    LDR    IS,WJV3,07F        SET UP DIVISOR
0980  FC31                    DIV    R,WJV1,WJV3        DIVIDE BY 127
0981  E021                    LDR    R,WJV1,WJV2        PUT DIVIDEND IN REG 1
0982  4002                    LDR    IS,WJV2,0          CLEAR REGISTER
0983  40A3                    LDR    IS,WJV3,10         SET UP DIVISOR
0984  FC31                    DIV    R,WJV1,WJV3        DIVIDE BY 10
0985  E014                    LDR    R,WJV4,WJV1        PUT REMAINDER IN REG 4 (DIGIT 1)
0986  E021                    LDR    R,WJV1,WJV2        SET UP DIVIDEND
0987  4002                    LDR    IS,WJV2,0          CLEAR REGISTER
0988  FC31                    DIV    R,WJV1,WJV3        DIVIDE BY 10
0989  AE31                    SHS    LL,WJV1,4          POSITION 2ND DIGIT
098A  AE72                    SHS    LL,WJV2,8          POSITION 3RD DIGIT
098B  A441                    IOR    R,WJV1,WJV4        COMBINE 1ST AND 2ND DIGITS
098C  A421                    IOR    R,WJV1,WJV2        COMBINE ALL DIGITS
098D  BF07                    BRC    R,7,RET            RETURN TO CALLER
                     .
                     .
                     .
                     .
                     .**********************************************************************
                     . BCD TO HEX ROUTINE (4 DIGIT BCD VALUE)
                     . BCD VALUE PASSED IN WJV2
                     . HEX VALUE RETURNED IN WJV1
                     . ROUTINE USES WJV1,WJV2,WJV3,WJV4
                     .**********************************************************************

098E  E021           WJBCDH   LDR    R,WJV1,WJV2        LOAD LEAST SIGNIFICANT BITS, PART 1
098F  A101 000F               AND    I,WJV1,0F            "     "          "       " , PART 2
0991  AD32                    SHS    RL,WJV2,4          SHIFT FOR MULTIPLICATION
0992  E023                    LDR    R,WJV3,WJV2        LOAD DUMMY REG FOR MULTIPLICATION
0993  A103 000F               AND    I,WJV3,15          CLEAR ALL BUT LEAST SIG BITS
0995  CD03 000A               MUL    I,WJV3,10          MULTIPLY BY 16
0997  8031                    ADD    R,WJV1,WJV3        ADD ONTO ANSWER
0998  AD32                    SHS    RL,WJV2,4          SHIFT FOR MULTIPLICATION
0999  E023                    LDR    R,WJV3,WJV2        LOAD DUMMY REG FOR MULTIPLICATION
099A  A103 000F               AND    I,WJV3,15          CLEAR ALL BUT LEAST SIG BITS
099C  CD03 0064               MUL    I,WJV3,064         MULTIPLY BY 100
099E  8031                    ADD    R,WJV1,WJV3        ADD ONTO ANSWER
099F  AD32                    SHS    RL,WJV2,4          SHIFT FOR MULTIPLICATION
09A0  CD02 03E8               MUL    I,WJV2,03E8        MULTIPLY BY 1000
09A2  8021                    ADD    R,WJV1,WJV2        ADD ONTO ANSWER
09A3  BF07                    BRC    R,7,RET            RETURN TO CALLER
                     .
                     .
                     .
                              PAGE
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ATAC                                                              TIME: 16:43:42     03/18/77     PAGE    19
LOC    OBJECT CODE      CARD IMAGE                                                                        CARDNUM
                                                                                                             955
                        .  ******************************                                                    956
                        .   ROUTINE TO OUTPUT LOOP MESSAGE                                                   957
                        .  ******************************                                                    958
09A4   E101 0BD2        WJCKP      LDR    I,WJV1,WJCP          LOAD ADDRESS OF OUTPUT                        959
09A6   400F                        LDR    IS,WJLPC,0           ZERO COUNTER                                  960
09A7   9C0F 09F6                   STR    D,WJLPC,WJLPK        SAVE ZERO COUNT                               961
09A9   ED00 0230                   BAL    I,RET,OUTPUT         OUTPUT LOOP BUFFER                            962
09AB   C107 0519                   BRCL   U,WJ02               RETURN TO RECEIVER CONTROL                    963
                        .                                                                                    964
                        .                                                                                    965
                        .                                                                                    966
                        .                                                                                    967
                        .*******************************************************************                 968
                        .  DATA BUFFERS                                                                      969
                        .*******************************************************************                 970
                        .                                                                                    971
                        .  RETURN ADDRESS                                                                    972
09AD                    WJRET      DS     1                    SAVE RETURN ADDRESS                           973
                        .                                                                                    974
                        .  XAR ADDRESSES                                                                     975
09AE   2300             WJCRS      DC     02300                XAR TO DETERMINE IF RECEIVER IS READY         976
09AF   2000             WJCRE      DC     02000                XAR FOR COMPLETION OF SEND/TRIGGER            977
09B0   2010             WJCRD1     DC     02010                XAR OUTPUT CONTROL WORD ONE                   978
09B1   2020             WJCRD2     DC     02020                XAR OUT TWO                                   979
09B2   2030             WJCRD3     DC     02030                XAR OUT THREE                                 980
09B3   2100             WJCRD4     DC     02100                XAR OUT FOUR                                  981
09B4   2330             WJCRF      DC     02330                DISABLE RECEIVER                              982
09B5   2230             WJRCD1     DC     02230                XAR INPUT CONTRCL WORD ONE                    983
09B6   2220             WJRCD2     DC     02220                XAR IN TWO                                    984
09B7   2210             WJRCD3     DC     02210                XAR IN THREE                                  985
09B8   2200             WJRCD4     DC     02200                XAR IN FOUR                                   986
09B9   2110             WJRCB      DC     02110                XAR TO START INPUT/STOP MONITOR CLOCK         987
09BA   2120             WJRCE      DC     02120                XAR END INPUT/START MONITOR CLOCK             988
09BB   2130             WJCRO      DC     02130                ENABLE RECEIVER XAR                           989
                        .                                                                                    990
                        .  INITIAL CONTROL WORD                                                              991
09BC   0055             WJI1       DC     00055                INITIAL CONTROL WORD 1                        992
09BD   000A             WJI2       DC     0000A                INITIAL CONTROL WORD 2                        993
09BE   0400             WJI3       DC     00400                INITIAL CONTROL WORD 3                        994
09BF   0000             WJI4       DC     00000                INITIAL CONTROL WORD 4                        995
                        .                                                                                    996
                        .  INITIAL CONTROL WORD - DISPLAY FORMAT                                             997
09C0   5000             WJICD      DC     05000                CONTROL FREQUENCY (LOWER)                     998
09C1   0005                        DC     00005                CONTROL FREQUENCY (UPPER)                     999
09C2   0000                        DC     0                    CONTROL DETECT MODE                          1000
09C3   5500                        DC     05500                CONTROL BFO FREQUENCY (LOWER)                1001
09C4   0004                        DC     04                   CONTROL BFO FREQUENCY (UPPER)                1002
09C5   0002                        DC     00002                CONTROL GAIN MODE                            1003
09C6   0100                        DC     0100                 CONTROL RF GAIN                              1004
09C7   0004                        DC     04                   CONTROL IF BANDWIDTH                         1005
                        .                                                                                   1006
                        .  CONTRCI WORD                                                                     1007
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LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
09C8                  WJCW1    DS    1          RCVR CONTROL WORD 1                  1008
09C9                  WJCW2    DS    1                            2                  1009
09CA                  WJCW3    DS    1                            3                  1010
09CB                  WJCW4    DS    1                            4                  1011
                      .                                                             1012
                      . RECEIVED WORD FROM WJ                                       1013
09CC                  WJRS1    DS    1          RCVR SENT WORD 1                     1014
09CD                  WJRS2    DS    1                            2                  1015
09CE                  WJRS3    DS    1                            3                  1016
09CF                  WJRS4    DS    1                            4                  1017
                      .                                                             1018
                      . TENTATIVE VALUES - DISPLAY FORMAT                           1019
09D0                  WJTFL    DS    1          TENTATIVE FREQ(LOWER)                1020
09D1                  WJTFU    DS    1          TENTATIVE FREQ(UPPER)                1021
09D2                  WJTDM    DS    1          TENTATIVE DETECT MODE                1022
09D3                  WJTBL    DS    1          TENTATIVE BFO FREQ(LOWER)            1023
09D4                  WJTBU    DS    1          TENTATIVE BFO FREQ (UPPER)           1024
09D5                  WJTGM    DS    1          TENTATIVE GAIN MODE                  1025
09D6                  WJTRFG   DS    1          TENTATIVE RF GAIN                    1026
09D7                  WJTIF    DS    1          TENTATIVE IF BANDWIDTH               1027
                      .                                                             1028
                      . CONTROI VALUES - DISPLAY FORMAT                             1029
09D8                  WJCFL    DS    1          CONTROL FREQUENCY (LOWER)            1030
09D9                  WJCFU    DS    1          CONTROL FREQUENCY (UPPER)            1031
09DA                  WJCDM    DS    1          CONTROL DETECT MODE                  1032
09DB                  WJCBL    DS    1          CONTROL BFO FREQUENCY (LOWER)        1033
09DC                  WJCBU    DS    1          CONTROL BFO FREQUENCY (UPPER)        1034
09DD                  WJCGM    DS    1          CONTROL GAIN MODE                    1035
09DE                  WJCRFG   DS    1          CONTROL RF GAIN                      1036
09DF                  WJCIF    DS    1          CONTROL IF BANDWIDTH                 1037
                      .                                                             1038
                      . RECEIVED VALUES - DISPLAY FORMAT                            1039
09E0                  WJRFL    DS    1          RECEIVED FREQUENCY (LOWER)           1040
09E1                  WJRFU    DS    1          RECEIVED FREQUENCY (UPPER)           1041
09E2                  WJRDM    DS    1          RECEIVED DETECT MODE                 1042
09E3                  WJRBL    DS    1          RECEIVED BFO FREQUENCY (LOWER)       1043
09E4                  WJRBU    DS    1          RECEIVED BFO FREQUENCY (UPPER)       1044
09E5                  WJRGM    DS    1          RECEIVED GAIN MODE                   1045
09E6                  WJRRFG   DS    1          RECEIVED RF GAIN                     1046
09E7                  WJRIF    DS    2          RECEIVED IF BANDWIDTH                1047
09E9                  WJRSS    DS    1          RECEIVED SIGNAL STRENGTH             1048
                      .                                                             1049
                      .                                                             1050
                      . SCAN VARIABLES                                              1051
09EA                  WJSFUU   DS    1          UPPER LIMIT (UPPER)                  1052
09EB                  WJSFUL   DS    1          UPPER LIMIT (LOWER)                  1053
09EC                  WJSFLU   DS    1          LOWER LIMIT (UPPER)                  1054
09ED                  WJSFLL   DS    1          LOWER LIMIT (LOWER)                  1055
09EE                  WJSFIN   DS    1          FREQUENCY INCREMENT (8 KHZ MAX)      1056
09EF                  WJSFSS   DS    1          SIGNAL STRENGTH                      1057
09F0                  WJSCNT   DS    1          COUNT OF NUMBER OF SCAN PASSES       1058
                      .                                                             1059
                      . SAVE LOCATIONS FOR ALL WJ9- ROUTINES                        1060
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
09F1                  WJ90R     DS    1                                             1061
09F2                  WJ90S1    DS    1                                             1062
09F3                  WJ90S2    DS    1                                             1063
09F4                  CHKFLG1   DS    1           FLAG FOR COMMAND 6                1064
09F5                  WJLPL     DS    1           LOOP COUNTER STORAGE              1065
09F6                  WJLPK     DS    1           WJS COUNTER STORAGE               1066
                      .                                                             1067
                      . RECEIVER CONTROL TITLE BUFFER                               1068
09F7  0009            WJT       DC    9           RECEIVER CONTROL TITLE            1069
09F8  0D0A                      DC    0D0A        CR/LF                             1070
09F9  5245                      DC    5245        RE                                1071
09FA  4345                      DC    4345        CE                                1072
09FB  4956                      DC    4956        IV                                1073
09FC  4552                      DC    4552        ER                                1074
09FD  2043                      DC    2043         C                                1075
09FE  4F4E                      DC    4F4E        ON                                1076
09FF  5452                      DC    5452        TR                                1077
0A00  4F4C                      DC    4F4C        OL                                1078
0A01  0000                      DC    0           NULL                              1079
                      .                                                             1080
                      .                                                             1081
                      . COMMANDS BUFFER                                             1082
0A02  0047            WJINS     DC    71                                            1083
0A03  303D                      DC    0303D       0=                                1084
0A04  5345                      DC    5345        SE                                1085
0A05  542D                      DC    542D        T-                                1086
0A06  5550                      DC    5550        UP                                1087
0A07  0D0A                      DC    0D0A        CR/LF                             1088
0A08  313D                      DC    313D        1=                                1089
0A09  4449                      DC    4449        DI                                1090
0A0A  5350                      DC    5350        SP                                1091
0A0B  4C41                      DC    4C41        LA                                1092
0A0C  5920                      DC    5920        Y                                 1093
0A0D  5445                      DC    5445        TE                                1094
0A0E  4E54                      DC    4E54        NT                                1095
0A0F  4154                      DC    4154        AT                                1096
0A10  4956                      DC    4956        IV                                1097
0A11  450D                      DC    450D        E/CR                              1098
0A12  0A32                      DC    0A32        LF/2                              1099
0A13  3D44                      DC    3D44        =D                                1100
0A14  4953                      DC    4953        IS                                1101
0A15  504C                      DC    504C        PL                                1102
0A16  4159                      DC    4159        AY                                1103
0A17  2043                      DC    2043         C                                1104
0A18  4F4E                      DC    4F4E        ON                                1105
0A19  5452                      DC    5452        TR                                1106
0A1A  4F4C                      DC    4F4C        OL                                1107
0A1B  0D0A                      DC    0D0A        CR/LF                             1108
0A1C  333D                      DC    333D        3=                                1109
0A1D  4449                      DC    4449        DI                                1110
0A1E  5350                      DC    5350        SP                                1111
0A1F  4C41                      DC    4C41        LA                                1112
0A20  5920                      DC    5920        Y                                 1113
```

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ATAC                                                             TIME: 16:43:42      03/18/77      PAGE     22
LOC     OBJECT CODE      CARD IMAGE                                                                CARDNUM
0A21    5245                      DC      05245            RE                                          1114
0A22    4345                      DC      04345            CE                                          1115
0A23    4956                      DC      04956            IV                                          1116
0A24    4544                      DC      04544            ED                                          1117
0A25    0D0A                      DC      00D0A            CR/LF                                       1118
0A26    343D                      DC      0343D            4=                                          1119
0A27    454E                      DC      0454E            EN                                          1120
0A28    5445                      DC      05445            TE                                          1121
0A29    5220                      DC      05220            R                                           1122
0A2A    5445                      DC      05445            TE                                          1123
0A2B    4E54                      DC      04E54            NT                                          1124
0A2C    4154                      DC      04154            AT                                          1125
0A2D    4956                      DC      04956            IV                                          1126
0A2E    450D                      DC      0450D            E/CR                                        1127
0A2F    0A35                      DC      00A35            LF/5                                        1128
0A30    3D53                      DC      03D53            =S                                          1129
0A31    4341                      DC      04341            CA                                          1130
0A32    4E20                      DC      04E20            N                                           1131
0A33    0D0A                      DC      00D0A            CR/LF                                       1132
0A34    363D                      DC      0363D            6=                                          1133
0A35    5245                      DC      05245            RE                                          1134
0A36    4345                      DC      04345            CE                                          1135
0A37    4956                      DC      04956            IV                                          1136
0A38    4520                      DC      04520            E                                           1137
0A39    434F                      DC      0434F            CO                                          1138
0A3A    4E54                      DC      04E54            NT                                          1139
0A3B    524F                      DC      0524F            RO                                          1140
0A3C    4C20                      DC      04C20            L                                           1141
0A3D    0D0A                      DC      00D0A            CR/LF                                       1142
0A3E    373D                      DC      0373D            7=                                          1143
0A3F    444F                      DC      0444F            DO                                          1144
0A40    4E45                      DC      04E45            NE                                          1145
0A41    0D0A                      DC      00D0A            CR/LF                                       1146
0A42    383D                      DC      0383D            8=                                          1147
0A43    5245                      DC      05245            RE                                          1148
0A44    494E                      DC      0494E            IN                                          1149
0A45    4954                      DC      04954            IT                                          1150
0A46    494C                      DC      0494C            IL                                          1151
0A47    495A                      DC      0495A            IZ                                          1152
0A48    4520                      DC      04520            E                                           1153
0A49    0D0A                      DC      00D0A            CR/LF                                       1154
0A4A    0000                      DC      0                NULL                                        1155
                         .                                                                             1156
                         . FREQUENCY TITLE BUFFER                                                      1157
0A4B    0006             WJFB     DC      6                COUNT                                       1158
0A4C    4652                      DC      04652            FR                                          1159
0A4D    4551                      DC      04551            EQ                                          1160
0A4E    2028                      DC      02028             (                                          1161
0A4F    485A                      DC      0485A            HZ                                          1162
0A50    2920                      DC      02920            )                                           1163
0A51    0D0A                      DC      00D0A            CR/LF                                       1164
0A52    0000                      DC      0                NULL                                        1165
                         .                                                                             1166
```

LOC	OBJECT CODE	CARD IMAGE			CARDNUM
		. GAIN MODE TITLE BUFFER			1167
0A53	0018	WJGMB	DC	24	COUNT 1168
0A54	4741		DC	04741	GA 1169
0A55	494E		DC	0494E	IN 1170
0A56	204D		DC	0204D	M 1171
0A57	4F44		DC	04F44	OD 1172
0A58	450D		DC	0450D	ECR 1173
0A59	0A30		DC	00A30	LF0 1174
0A5A	3D48		DC	03D48	=H 1175
0A5B	4F4C		DC	04F4C	OL 1176
0A5C	4420		DC	04420	D 1177
0A5D	4147		DC	04147	AG 1178
0A5E	430D		DC	0430D	CCR 1179
0A5F	0A32		DC	00A32	LF2 1180
0A60	3D4E		DC	03D4E	=N 1181
0A61	4F52		DC	04F52	OR 1182
0A62	4D41		DC	04D41	MA 1183
0A63	4C20		DC	04C20	L 1184
0A64	4147		DC	04147	AG 1185
0A65	430D		DC	0430D	CCR 1186
0A66	0A33		DC	00A33	LF3 1187
0A67	3D4D		DC	03D4D	=M 1188
0A68	414E		DC	0414E	AN 1189
0A69	5541		DC	05541	UA 1190
0A6A	4C20		DC	04C20	L 1191
0A6B	0D0A		DC	00D0A	CR/LF 1192
0A6C	0000		DC	0	NULL 1193
		.			1194
		. IF BANDWIDTH TITLE BUFFER			1195
0A6D	001A	WJIFB	DC	26	COUNT 1196
0A6E	4946		DC	04946	IF 1197
0A6F	2042		DC	02042	B 1198
0A70	414E		DC	0414E	AN 1199
0A71	4457		DC	04457	DW 1200
0A72	4944		DC	04944	ID 1201
0A73	5448		DC	05448	TH 1202
0A74	0D0A		DC	00D0A	CR/LF 1203
0A75	313D		DC	0313D	1= 1204
0A76	3530		DC	03530	50 1205
0A77	3020		DC	03020	0 1206
0A78	485A		DC	0485A	HZ 1207
0A79	0D0A		DC	00D0A	CR/LF 1208
0A7A	323D		DC	0323D	2= 1209
0A7B	3220		DC	03220	2 1210
0A7C	4B48		DC	04B48	KH 1211
0A7D	5A0D		DC	05A0D	ZCR 1212
0A7E	0A33		DC	00A33	LF3 1213
0A7F	3D34		DC	03D34	=4 1214
0A80	204B		DC	0204B	K 1215
0A81	485A		DC	0485A	HZ 1216
0A82	0D0A		DC	00D0A	CR/LF 1217
0A83	343D		DC	0343D	4= 1218
0A84	3820		DC	03820	8 1219

```
LOC   OBJECT CODE     CARD IMAGE                                                 CARDNUM
0A85  4B48                    DC      04B48            KH                          1220
0A86  5A20                    DC      05A20            Z                           1221
0A87  0D0A                    DC      00D0A            CR/LF                       1222
0A88  0000                    DC      0                NULL                        1223
                  *                                                                1224
                  . DETECT MODE TITLE BUFFER                                       1225
0A89  0028        WJDMB       DC      40               COUNT                       1226
0A8A  4445                    DC      04445            DE                          1227
0A8B  5445                    DC      05445            TE                          1228
0A8C  4354                    DC      04354            CT                          1229
0A8D  204D                    DC      0204D             M                          1230
0A8E  4F44                    DC      04F44            OD                          1231
0A8F  450D                    DC      0450D            ECR                         1232
0A90  0A30                    DC      00A30            LF0                         1233
0A91  3D41                    DC      03D41            =A                          1234
0A92  4D0D                    DC      04D0D            MCR                         1235
0A93  0A31                    DC      00A31            LF1                         1236
0A94  3D46                    DC      03D46            =F                          1237
0A95  4D0D                    DC      04D0D            MCR                         1238
0A96  0A32                    DC      00A32            LF2                         1239
0A97  3D42                    DC      03D42            =B                          1240
0A98  464F                    DC      0464F            FO                          1241
0A99  2046                    DC      02046             F                          1242
0A9A  4958                    DC      04958            IX                          1243
0A9B  4544                    DC      04544            ED                          1244
0A9C  0D0A                    DC      00D0A            CR/LF                       1245
0A9D  333D                    DC      0333D            3=                          1246
0A9E  4246                    DC      04246            BF                          1247
0A9F  4F20                    DC      04F20            O                           1248
0AA0  5641                    DC      05641            VA                          1249
0AA1  520D                    DC      0520D            RCR                         1250
0AA2  0A34                    DC      00A34            LF4                         1251
0AA3  3D49                    DC      03D49            =I                          1252
0AA4  5342                    DC      05342            SB                          1253
0AA5  0D0A                    DC      00D0A            CR/LF                       1254
0AA6  353D                    DC      0353D            5=                          1255
0AA7  4C53                    DC      04C53            LS                          1256
0AA8  420D                    DC      0420D            BCR                         1257
0AA9  0A36                    DC      00A36            LF6                         1258
0AAA  3D55                    DC      03D55            =U                          1259
0AAB  5342                    DC      05342            SB                          1260
0AAC  0D0A                    DC      00D0A            CR/LF                       1261
0AAD  373D                    DC      0373D            7=                          1262
0AAE  414D                    DC      0414D            AM                          1263
0AAF  2D4E                    DC      02D4E            -N                          1264
0AB0  4C20                    DC      04C20            L                           1265
0AB1  0D0A                    DC      00D0A            CR/LF                       1266
0AB2  0000                    DC      0                NULL                        1267
                  *                                                                1268
                  . BFO FREQUENCY TITLE BUFFER                                     1269
0AB3  0015        WJBFB       DC      21               COUNT                       1270
0AB4  4246                    DC      04246            BF                          1271
0AB5  4F20                    DC      04F20            O                           1272
```

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LOC   OBJECT CODE      CARD IMAGE                                              CARDNUM
0AB6  4652                       DC     04652          FR                         1273
0AB7  4551                       DC     04551          EQ                         1274
0AB8  2028                       DC     02028           (                         1275
0AB9  485A                       DC     0485A          HZ                         1276
0ABA  2920                       DC     02920          )                          1277
0ABB  0D0A                       DC     00D0A          CR/LF                      1278
0ABC  3434                       DC     03434          44                         1279
0ABD  3520                       DC     03520          5                          1280
0ABE  4B48                       DC     04B48          KH                         1281
0ABF  5A20                       DC     05A20          Z                          1282
0AC0  544F                       DC     0544F          TO                         1283
0AC1  2034                       DC     02034           4                         1284
0AC2  3635                       DC     03635          65                         1285
0AC3  204B                       DC     0204B           K                         1286
0AC4  485A                       DC     0485A          HZ                         1287
0AC5  2049                       DC     02049           I                         1288
0AC6  4E20                       DC     04E20          N                          1289
0AC7  485A                       DC     0485A          HZ                         1290
0AC8  0D0A                       DC     00D0A          CR/LF                      1291
0AC9  0000                       DC     0              NULL                       1292
                                                                                  1293
                       ;RF GAIN TITLE BUFFER                                      1294
CACA  000C             WJRFGB    DC     12             COUNT                      1295
0ACB  5246                       DC     05246          RF                         1296
0ACC  2047                       DC     02047           G                         1297
0ACD  4149                       DC     04149          AI                         1298
0ACE  4E0D                       DC     04E0D          NCR                        1299
0ACF  0A28                       DC     00A28          LF(                        1300
0AD0  5045                       DC     05045          PE                         1301
0AD1  5243                       DC     05243          RC                         1302
0AD2  454E                       DC     0454E          EN                         1303
0AD3  5441                       DC     05441          TA                         1304
0AD4  4745                       DC     04745          GE                         1305
0AD5  2920                       DC     02920          )                          1306
0AD6  0D0A                       DC     00D0A          CR/LF                      1307
0AD7  0000                       DC     0              NULL                       1308
                                                                                  1309
                       ; FREQUENCY TITLE FOR DISPLAY                              1310
CAD8  000B             WJDF      DC     11             COUNT                      1311
0AD9  4652                       DC     04652          FR                         1312
0ADA  4551                       DC     04551          EQ                         1313
0ADB  203D                       DC     0203D           =                         1314
0ADC  2020                       DC     02020                                     1315
0ADD  2020             WJDF1     DC     02020          XX                         1316
0ADE  2020                       DC     02020          XX                         1317
0ADF  2020                       DC     02020          XX                         1318
0AE0  2020                       DC     02020          XX                         1319
0AE1  2048                       DC     02048           H                         1320
0AE2  5A20                       DC     05A20          Z                          1321
0AE3  0D0A                       DC     00D0A          CR/LF                      1322
0AE4  0000                       DC     0              NULL                       1323
                                                                                  1324
                       ; DETECT MODE TITLE FOR DISPLAY                            1325
```

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LOC   OBJECT CODE      CARD IMAGE                                                          CARDNUM
0AE5  0007          WJDDM     DC    7                   COUNT                                 1326
0AE6  4445                    DC    04445               DE                                    1327
0AE7  5445                    DC    05445               TE                                    1328
0AE8  4354                    DC    04354               CT                                    1329
0AE9  204D                    DC    0204D                M                                    1330
0AEA  4F44                    DC    04F44               OD                                    1331
0AEB  4520                    DC    04520               E                                     1332
0AEC  3D20                    DC    03D20               =                                     1333
0AED  0000                    DC    0                   NULL                                  1334
                    *                                                                         1335
                    : BFO FREQUENCY TITLE FOR DISPLAY                                         1336
0AEE  000B          WJDBF     DC    11                  COUNT                                 1337
0AEF  4246                    DC    04246               BF                                    1338
0AF0  4F20                    DC    04F20               O                                     1339
0AF1  4652                    DC    04652               FR                                    1340
0AF2  4551                    DC    04551               EQ                                    1341
0AF3  203D                    DC    0203D                =                                    1342
0AF4  2034                    DC    02034                4                                    1343
0AF5  2020          WJDBF1    DC    02020               XX                                    1344
0AF6  2020                    DC    02020               XX                                    1345
0AF7  3020                    DC    03020               0                                     1346
0AF8  485A                    DC    0485A               HZ                                    1347
0AF9  0D0A                    DC    00D0A               CR/LF                                 1348
0AFA  0000                    DC    0                   NULL                                  1349
                    *                                                                         1350
                    : GAIN MODE TITLE FOR DISPLAY                                             1351
0AFB  0006          WJDGM     DC    6                   COUNT                                 1352
0AFC  4741                    DC    04741               GA                                    1353
0AFD  494E                    DC    0494E               IN                                    1354
0AFE  204D                    DC    0204D                M                                    1355
0AFF  4F44                    DC    04F44               OD                                    1356
0B00  4520                    DC    04520               E                                     1357
0B01  3D20                    DC    03D20               =                                     1358
0B02  0000                    DC    0                   NULL                                  1359
                    *                                                                         1360
                    : IF BANDWIDTH TITLE FOR DISPLAY                                          1361
0B03  0008          WJDIF     DC    8                   COUNT                                 1362
0B04  4946                    DC    04946               IF                                    1363
0B05  2042                    DC    02042                B                                    1364
0B06  414E                    DC    0414E               AN                                    1365
0B07  4457                    DC    04457               DW                                    1366
0B08  4944                    DC    04944               ID                                    1367
0B09  5448                    DC    05448               TH                                    1368
0B0A  203D                    DC    0203D                =                                    1369
0B0B  2020                    DC    02020                                                     1370
0B0C  0000                    DC    0                   NULL                                  1371
                    *                                                                         1372
                    : RF GAIN TITLE FOR DISPLAY                                               1373
0B0D  0009          WJDRF     DC    9                   COUNT                                 1374
0B0E  5246                    DC    05246               RF                                    1375
0B0F  2047                    DC    02047                G                                    1376
0B10  4149                    DC    04149               AI                                    1377
0B11  4E20                    DC    04E20               N                                     1378
```

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LOC   OBJECT CODE      CARD IMAGE                                                   CARDNUM
0B12  3D20                     DC    03D20            =                                1379
0B13  2020             WJDRF1  DC    02020            XX                               1380
0B14  2020                     DC    02020            XX                               1381
0B15  2520                     DC    02520            %                                1382
0B16  0D0A                     DC    00D0A            CR/LF                            1383
0B17  0000                     DC    0                NULL                             1384
                       .                                                               1385
                       . SIGNAL STRENGTH TITLE FOR DISPLAY                             1386
0B18  000D             WJDSS   DC    13               COUNT                            1387
0B19  5349                     DC    05349            SI                               1388
0B1A  474E                     DC    0474E            GN                               1389
0B1B  414C                     DC    0414C            AL                               1390
0B1C  2053                     DC    02053             S                               1391
0B1D  5452                     DC    05452            TR                               1392
0B1E  454E                     DC    0454E            EN                               1393
0B1F  4754                     DC    04754            GT                               1394
0B20  4820                     DC    04820            H                                1395
0B21  3D20                     DC    03D20            =                                1396
0B22  2020             WJDSS1  DC    02020            XX                               1397
0B23  2020                     DC    02020            XX                               1398
0B24  2520                     DC    02520            %                                1399
0B25  0D0A                     DC    0D0A             CR/LF                            1400
0B26  0000                     DC    0                NULL                             1401
                       .                                                               1402
                       . TABLE OF GAIN MODES FOR DISPLAY                               1403
0B27  0B2B             WJGMTB  DC    WJGM0            HOLD AGC                         1404
0B28  0B32                     DC    WJGM1            NOT USED                         1405
0B29  0B34                     DC    WJGM2            NORMAL AGC                       1406
0B2A  0B3C                     DC    WJGM3            MANUAL                           1407
                       .                                                               1408
                       .                                                               1409
0B2B  0005             WJGM0   DC    5                COUNT/HOLD AGC                   1410
0B2C  484F                     DC    0484F            HO                               1411
0B2D  4C44                     DC    04C44            LD                               1412
0B2E  2041                     DC    02041             A                               1413
0B2F  4743                     DC    04743            GC                               1414
0B30  0D0A                     DC    00D0A            CR/LF                            1415
0B31  0000                     DC    0                NULL                             1416
                       .                                                               1417
                       .                                                               1418
0B32  FFFF             WJGM1   DC    -1               COUNT/INVALID ENTRY              1419
0B33  0000                     DC    0                NULL                             1420
                       .                                                               1421
                       .                                                               1422
0B34  0006             WJGM2   DC    6                COUNT/NORMAL AGC                 1423
0B35  4E4F                     DC    04E4F            NO                               1424
0B36  524D                     DC    0524D            RM                               1425
0B37  414C                     DC    0414C            AL                               1426
0B38  2041                     DC    02041             A                               1427
0B39  4743                     DC    04743            GC                               1428
0B3A  0D0A                     DC    00D0A            CR/LF                            1429
0B3B  0000                     DC    0                NULL                             1430
                       .                                                               1431
```

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ATAC                                                          TIME: 16:43:42     03/18/77     PAGE    28
LOC   OBJECT CODE     CARD IMAGE                                                                  CARDNUM
                     .                                                                              1432
0B3C  0004           WJGM3    DC     4                    COUNT/MANUAL                             1433
0B3D  4D41                    DC     04D41                MA                                       1434
0B3E  4E55                    DC     04E55                NU                                       1435
0B3F  414C                    DC     0414C                AL                                       1436
0B40  0D0A                    DC     00D0A                CR/LF                                    1437
0B41  0000                    DC     0                    NULL                                     1438
                     .                                                                              1439
                     . TABLE CF IF BANDWIDTHS FOR DISPLAY                                           1440
0B42  0B47           WJIFIB   DC     WJIF0                NOT USED                                 1441
0B43  0B49                    DC     WJIF1                500HZ                                    1442
0B44  0B4F                    DC     WJIF2                2KHZ                                     1443
0B45  0B55                    DC     WJIF3                4KHZ                                     1444
0B46  0B5B                    DC     WJIF4                8KHZ                                     1445
                     .                                                                              1446
                     .                                                                              1447
0B47  FFFF           WJIF0    DC     -1                   COUNT/INVALID ENTRY                      1448
0B48  0000                    DC     0                    NULL                                     1449
                     .                                                                              1450
                     .                                                                              1451
0B49  0004           WJIF1    DC     4                    COUNT/500KHZ                             1452
0B4A  3530                    DC     03530                50                                       1453
0B4B  3020                    DC     03020                0                                        1454
0B4C  485A                    DC     0485A                HZ                                       1455
0B4D  0D0A                    DC     00D0A                CR/LF                                    1456
0B4E  0000                    DC     0                    NULL                                     1457
                     .                                                                              1458
                     .                                                                              1459
0B4F  0004           WJIF2    DC     4                    COUNT/2KHZ                               1460
0B50  3220                    DC     03220                2                                        1461
0B51  4B48                    DC     04B48                KH                                       1462
0B52  5A20                    DC     05A20                Z                                        1463
0B53  0D0A                    DC     00D0A                CR/LD                                    1464
0B54  0000                    DC     0                    NULL                                     1465
                     .                                                                              1466
                     .                                                                              1467
0B55  0004           WJIF3    DC     4                    COUNT/4KHZ                               1468
0B56  3420                    DC     03420                4                                        1469
0B57  4B48                    DC     04B48                KH                                       1470
0B58  5A20                    DC     05A20                Z                                        1471
0B59  0D0A                    DC     00D0A                CR/LF                                    1472
0B5A  0000                    DC     0                    NULL                                     1473
                     .                                                                              1474
                     .                                                                              1475
0B5B  0004           WJIF4    DC     4                    COUNT/8 KHZ                              1476
0B5C  3820                    DC     03820                8                                        1477
0B5D  4B48                    DC     04B48                KH                                       1478
0B5E  5A20                    DC     05A20                Z                                        1479
0B5F  0D0A                    DC     00D0A                CR/LF                                    1480
0B60  0000                    DC     0                    NULL                                     1481
                     .                                                                              1482
                     . TABLE CF DETECT MODES FOR DISPLAY                                            1483
0B61  0B69           WJDMTB   DC     WJDM1                AM                                       1484
```

```
LOC   OBJECT CODE     CARD IMAGE                                                              CARDNUM
0E62  0B6D                    DC     WJDM2                FM                                   1485
0B63  0B71                    DC     WJDM3                BFO  FIXED                           1486
0B64  0B79                    DC     WJDM4                BFO  VARIABLE                        1487
0B65  0B82                    DC     WJDM5                ISB                                  1488
0B66  0B87                    DC     WJDM6                LSB                                  1489
0E67  0B8C                    DC     WJDM7                USB                                  1490
0B68  0B91                    EC     WJDM8                AM-NL                                1491
                      .                                                                        1492
                                                                                               1493
0B69  0002            WJDM1   DC     2                    COUNT/AM                             1494
0B6A  414D                    DC     0414D                AM                                   1495
0B6B  0D0A                    DC     00D0A                CR/LF                                1496
0B6C  0000                    DC     0                    NULL                                 1497
                      .                                                                        1498
                                                                                               1499
0B6D  0002            WJDM2   DC     2                    COUNT/FM                             1500
0B6E  464D                    DC     0464D                FM                                   1501
0B6F  0D0A                    DC     00D0A                CR/LF                                1502
0B70  0000                    DC     0                    NULL                                 1503
                      .                                                                        1504
                                                                                               1505
0B71  0006            WJDM3   DC     6                    COUNT/BFO FIXED                      1506
0B72  4246                    DC     04246                BF                                   1507
0B73  4F20                    DC     04F20                O                                    1508
0B74  4649                    DC     04649                FI                                   1509
0B75  5845                    DC     05845                XE                                   1510
0B76  4420                    EC     04420                D                                    1511
0B77  0D0A                    DC     00D0A                CR/LF                                1512
0B78  0000                    EC     0                    NULL                                 1513
                      .                                                                        1514
                                                                                               1515
0B79  0007            WJDM4   DC     7                    COUNT/BFO VARIAELE                   1516
0B7A  4246                    EC     04246                BF                                   1517
0B7B  4F20                    DC     04F20                O                                    1518
0B7C  5641                    DC     05641                VA                                   1519
0B7D  5249                    DC     05249                RI                                   1520
0B7E  4142                    EC     04142                AB                                   1521
0B7F  4C45                    EC     04C45                LE                                   1522
0B80  0D0A                    DC     00D0A                CR/LF                                1523
0B81  0000                    DC     0                    NULL                                 1524
                      .                                                                        1525
                                                                                               1526
0B82  0003            WJDM5   DC     3                    COUNT/ISB                            1527
0B83  4953                    DC     04953                IS                                   1528
0B84  4220                    DC     04220                B                                    1529
0B85  0D0A                    DC     00D0A                CR/LF                                1530
0B86  0000                    DC     0                    NULL                                 1531
                      .                                                                        1532
                                                                                               1533
0B87  0003            WJDM6   DC     3                    COUNT/LSB                            1534
0B88  4C53                    LC     04C53                LS                                   1535
0B89  4220                    DC     04220                B                                    1536
0B8A  0D0A                    EC     00D0A                CR/LF                                1537
```

```
ATAC                                                                    TIME: 16:43:42      03/18/77      PAGE    30
LOC   OBJECT CODE      CARD IMAGE                                                                             CARDNUM
0B8B  0000                       DC      0                  NULL                                                 1538
                       .                                                                                         1539
                       .                                                                                         1540
0B8C  0003             WJDM7     DC      3                  COUNT/USB                                            1541
0B8D  5553                       DC      05553              US                                                   1542
0B8E  4220                       DC      04220              B                                                    1543
0B8F  0D0A                       DC      00D0A              CR/LF                                                1544
0B90  0000                       DC      0                  NULL                                                 1545
                       .                                                                                         1546
                       .                                                                                         1547
0B91  0004             WJDM8     DC      4                  COUNT/AM-NL                                          1548
0B92  414D                       DC      0414D              AM                                                   1549
0B93  2D4E                       DC      02D4E              -N                                                   1550
0B94  4C20                       DC      04C20              L                                                    1551
0B95  0D0A                       DC      00D0A              CR/LF                                                1552
0B96  0000                       DC      0                  NULL                                                 1553
                       .                                                                                         1554
                       . SCAN TITLE                                                                              1555
0B97  0003             WJSCAN    DC      3                  COUNT                                                1556
0B98  5343                       DC      05343              SC                                                   1557
0B99  414E                       DC      0414E              AN                                                   1558
0B9A  0D0A                       DC      00D0A              CR/LF                                                1559
0B9B  0000                       DC      0                  NULL                                                 1560
                       .                                                                                         1561
                       . START FREQUENCY TITLE                                                                   1562
0B9C  0009             WJSFS     DC      9                  COUNT                                                1563
0B9D  5354                       DC      05354              ST                                                   1564
0B9E  4152                       DC      04152              AR                                                   1565
0B9F  5420                       DC      05420              T                                                    1566
0BA0  4652                       DC      04652              FR                                                   1567
0BA1  4551                       DC      04551              EQ                                                   1568
0BA2  2049                       DC      02049               I                                                   1569
0BA3  4E20                       DC      04E20              N                                                    1570
0BA4  485A                       DC      0485A              HZ                                                   1571
0BA5  0D0A                       DC      00D0A              CR/LF                                                1572
0BA6  0000                       DC      0                  NULL                                                 1573
                       .                                                                                         1574
                       . END FREQUENCY TITLE                                                                     1575
0BA7  0008             WJSFE     DC      8                  COUNT                                                1576
0BA8  454E                       DC      0454E              EN                                                   1577
0BA9  4420                       DC      04420              D                                                    1578
0BAA  4652                       DC      04652              FR                                                   1579
0BAB  4551                       DC      04551              EQ                                                   1580
0BAC  2049                       DC      02049               I                                                   1581
0BAD  4E20                       DC      04E20              N                                                    1582
0BAE  485A                       DC      0485A              HZ                                                   1583
0BAF  0D0A                       DC      00D0A              CR/LF                                                1584
0BB0  0000                       DC      0                  NULL                                                 1585
                       .                                                                                         1586
                       . FREQUENCY INCREMENT TITLE                                                               1587
0BB1  000B             WJSFI     DC      11                 COUNT                                                1588
0BB2  4652                       DC      04652              FR                                                   1589
0BB3  4551                       DC      04551              EQ                                                   1590
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
0BB4  2049                    DC    02049          I                                   1591
0BB5  4E43                    DC    04E43         NC                                   1592
0BB6  5245                    DC    05245         RE                                   1593
0BB7  4D45                    DC    04D45         ME                                   1594
0BB8  4E54                    DC    04E54         NT                                   1595
0BB9  2049                    DC    02049          I                                   1596
0BBA  4E20                    DC    04E20         N                                    1597
0BBB  485A                    DC    0485A         HZ                                   1598
0BBC  0D0A                    DC    00D0A         CR/LF                                1599
0BBD  0000                    DC    0             NULL                                 1600
                      .                                                                1601
                      . SIGNAL STRENGTH TITLE                                          1602
0BBE  000A            WJSSS   DC    10            COUNT                                1603
0BBF  5349                    DC    05349         SI                                   1604
0BC0  474E                    DC    0474E         GN                                   1605
0BC1  414C                    DC    0414C         AL                                   1606
0BC2  2053                    DC    02053          S                                   1607
0BC3  5452                    DC    05452         TR                                   1608
0BC4  454E                    DC    0454E         EN                                   1609
0BC5  4754                    DC    04754         GT                                   1610
0BC6  4820                    DC    04820         H                                    1611
0BC7  2520                    DC    02520         %                                    1612
0BC8  0D0A                    DC    00D0A         CR/LF                                1613
0BC9  0000                    DC    0             NULL                                 1614
                      .                                                                1615
                      . NO FIND MESSAGE FOR SCAN                                       1616
0BCA  0006            WJSNF   DC    6             COUNT                                1617
0BCB  4E4F                    DC    04E4F         NO                                   1618
0BCC  2053                    DC    02053          S                                   1619
0BCD  4947                    DC    04947         IG                                   1620
0BCE  4E41                    DC    04E41         NA                                   1621
0BCF  4C20                    DC    04C20         L                                    1622
0BD0  0D0A                    DC    00D0A         CR/LF                                1623
0BD1  0000                    DC    0             NULL                                 1624
                      .                                                                1625
                      .                                                                1626
                      .  LCOF MESSAGE                                                  1627
0BD2  001D            WJCF    DC    29            COUNT                                1628
0BD3  0707                    DC    00707         BELL BELL                            1629
0BD4  494E                    DC    0494E         IN                                   1630
0BD5  4649                    DC    04649         FI                                   1631
0BD6  4E49                    DC    04E49         NI                                   1632
0BD7  5445                    DC    05445         TE                                   1633
0BD8  204C                    DC    0204C          L                                   1634
0BD9  4F4F                    DC    04F4F         OO                                   1635
0BDA  500D                    DC    0500D         PCR                                  1636
0BDB  0A5D                    DC    00A5D         LFP                                  1637
0BDC  4C45                    DC    04C45         LE                                   1638
0BDD  4153                    DC    04153         AS                                   1639
0BDE  4520                    DC    04520         E                                    1640
0BDF  4348                    DC    04348         CH                                   1641
0BE0  4543                    DC    04543         EC                                   1642
0BE1  4B20                    DC    04B20         K                                    1643
```

```
LOC   OBJECT CODE     CARD IMAGE                                                  CARDNUM
0BE2  494E                    DC    0494E     IN                                  1644
0BE3  5445                    DC    05445     TE                                  1645
0BE4  5246                    DC    05246     RF                                  1646
0BE5  4143                    DC    04143     AC                                  1647
0BE6  4520                    DC    04520     E                                   1648
0BE7  414E                    DC    0414E     AN                                  1649
0BE8  4420                    DC    04420     D                                   1650
0BE9  5245                    DC    05245     RE                                  1651
0BEA  4345                    DC    04345     CE                                  1652
0BEB  4956                    DC    04956     IV                                  1653
0BEC  4552                    DC    04552     ER                                  1654
0BED  C707                    DC    00707     BELL BELL                           1655
0BEE  0D0A                    DC    00D0A     CR/LF                               1656
0BEF  0000                    DC    0000      NULL                                1657
                              PAGE                                                1658
                                                                                  1659
```

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